W. D. H.

Health Education

BY

MAMIE C. TEX

FOR

EIGHTH YEAR

To Harmonize with the Illincis State Course of Study, Seventh General Revision

TREATS ALL THE WORK ON EIGHTH YEAR HEALTH EDUCATION

PRICE 75 CENTS

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FOREWORD.

An experience of several years in teaching this subject has proved that no one text book now in use is adapted to the demands of our Course of Study, and in order to meet these requirements, I present this booklet.

It has been prepared expressly for my own classes, but it has also been the aim to adapt it to the use of any class in the Eighth Year following the Illinois State Course of Study. No pains have been spared to make it as accurate and complete as possible.

It is not to be presumed that this booklet contains all that might be said on each topic, but such material is given as the average Eighth Year pupil can understand and assimilate.

In conclusion, this volume is submitted to you, my dear pupils and co-workers with the hope that it will perform its mission as designed.

MAMIE C. TEX,
Taylorville, Ill.

December 1, 1925.

FIRST QUARTER.

Note—The Course of Study says the work outlined under your "Science and Agriculture" is the basis for class studies during this quarter. Place much emphasis on the house flies and mosquitos, the places where they breed and their life hisories.

Teacher must see to it that pupils review the work in their "Science and Agriculture." That work was not included in this Health Education becouse it was unnecessary expense to print it twice, therefore have the pupils refer to their Science and Agriculture and after this is done, take up the Framework of our Body, etc.

Every day, scientists are coming more and more to the conclusion that every factor of our environment plays a more or less important part in our physical well being. Nothing is so insignificant that it does not play its part in promoting or retarding the health and well being of the human race. Because of this new linking of the two sciences—botany and physiology (including hygiene) an attempt has been made this year to so corrolate the two subjects that their relationship may be made very clear to every student.

When we speak of botany we must include with it zoology, or the study of our animal life, as botany is the study of our plant life. When the term physiology is used, likewise we include the study of hygiene or sanitary living.

But to see any relation between these four more or less distinct branches of science, we must choose one, and around that as a nucleus, group the other three, showing their relations to the main topic as well as to each other.

Since man and his well being is our chief interest, let us choose physiology—or the physical structure of man—and around it group botany, zoology, and hygiene.

We have had more or less physiology in earlier grades, so that the terminology and underlying facts are more or less known

to us. But to be sure that the bodily structure, its parts and their functions are quite clear to us, we will have a short review of them.

Let us take the bony framework of our body.

Framework of Our Body.

The bones are a framework of rods and plates which make the body firmer and stiffen it for movement. *All the bones properly fitted form what is called the skeleton.* No doubt you have seen the skeleton of some animals and perhaps that of a human being. You have observed that the bones outlast the other parts of the body substances. Long after the animal, or fleshy substance has decayed the bones are well preserved.

The bones give the body its shape and strength and besides furnish places for the attachment of the muscles. As the muscles are tied to the bones, we are enabled to move our limbs, thus causing such acts as walking, running, throwing, turning, bending and all other movements. The bones also determine the size of the body. A small boned person is always little in stature.

Besides the uses that have been given, *the bones protect certain organs of the body.* The bones of the skull protect the brain, while the bones of the spinal column protect the spinal cord. The delicate organs of the ear and eye as well as the nose are protected by a bony covering. The internal organs are also very well protected.

No one can study the human skeleton and fail to appreciate what nature has done in perfecting man's body. Beginning with the head, we see how admirably every part is adapted for the work it is expected to do. *The trunk, the upper and lower extremities, and the head complete the parts of the body.*

In considering the general plan of the body, we note one significant fact and that is, that man is the only animal that can walk upright. Note for contrast the ape—by many considered our next kin. His head is so balanced he can not hold it upright for any length of time. The unusual length of his forearms shows that nature intended them to be used in walking. With

man it is quite different. His arms are in such proportion to the rest of his body as to be of use to him for purposes other than that of locomotion.

There are twenty-two bones in the skull—eight in the cranium and fourteen in the face. The cranium bones are:

1 frontal
2 temporal
2 parietal
1 occipital
1 ethmoid
1 sphenoid

The bones of the face are:

1 vomer
2 palate
2 nasal
2 lachrymal
2 malar
2 superior maxillary
1 inferior maxillary
2 turbinated

The bones of the trunk number fifty-four in all. They include the ribs, breast bone, the pelvis, and the back bone. The tongue bone is also one of the bones of the trunk. There are twenty-four ribs, twelve on each side. The seven upper are called the *true ribs* and the five lower are called the *false ribs*. The *breast bone* occupies the front of the chest. The *pelvis* furnishes a support upon which the organs of the abdomen rest. The *back bone* is composed of twenty-four vertebrae. The upper seven are called the *cervical vertbrae,* and are located in the neck. The next twelve are called the *dorsal vertebrae* and the next five are called the *lumbar vertebrae*. All of these bones, together form a bony box that protects the most vital organs of man, the lungs, heart, stomach, liver, kidneys, and intestines. The back bone is not perfectly straight but makes a series of curves. These curves are forward in the neck and abdomen. These curves help to protect the brain from sudden jars. Between the

little bones in the back bones are thick pads of gristle which serve as springs or cushions. The vertebrae are held together firmly by ligaments so that the back has a great deal of strength. There is an opening through the spinal column for the passage of the spinal cord. The "atlas" is at the top of the spinal column and supports the head. It is not shaped like the other vertebrae and has no cushions above or below. The "axis" forms a pivot on which the head turns. These bones make possible the forward and backward movements of the head as well as those from side to side. In other words they enable one to move the head in many ways.

At the lower end of the spinal column are *two very irregular bones;* these two irregular bones in childhood are composed of nine pieces, five of which unite to form one bone and four the other.

The bones of the upper limbs consist of the *collar bone,* the *shoulder blade,* the *upper arm bone,* the *lower arm bones,* the *bones of the wrist,* and the *bones of the fingers.*

The collar bone is a long, slender bone, at one end fastened to the breast bone, and at the other end it is attached to the shoulder blade. This bone keeps the shoulder from falling to the chest.

The shoulder blade is a thin, flat triangular bone. It lies outside of the ribs, in the back of the chest.

The upper arm bone is called the *humerus,* and the lower arm bones are the *luna and radius.* The ulna is on the inside of the arm and the radius on the outside. These bones cross when the hand is turned.

There are eight little bones in the wrist and they are called the *carpal bones.*

In the palm of the hand are five bones, and are called the *meta carpal bones.* There are fourteen bones in the finges called the *phalanges.*

The bones of the lower extremities are the *femur, patella, the leg,* and *the foot.*

The femur or thigh bone is the longest bone in the body. It extends from the hip joint to the knee.

The patella or knee pan, is a chestnut shaped bone.

The two lower leg bones are called the *tibia* and *fibula.* They extend from the knee to the ankle. The tibia is the larger bone and is in front of the fibula.

There is *a heel bone* and six bones in the ankle known as the *tarsal bones.*

In the instep are five bones called the *metatarsal bones.* In the toes are fourteen bones called the *phalanges.*

Function of Curves in the Spinal Column, Arches of Foot and Joints in Protecting Body from Jar.

The chief function of the curves in the spinal column is to prevent jar to the head. If the spinal column were straight and rigid, every time we jumped from a height of our head would receive such a jolt it would almost render us unconscious. The curves in the spine may be likened to Ford "shock absorbers."

The curves in the arches of the foot are to give elasticity to our steps. We have but to note the difference in the way a young person walks and in the way an old man plods along. The young person steps quickly and gracefully while the old person plants the foot firmly and slowly upon the ground. If this arch is lacking in the young, we speak of it as "flat foot." In the late draft 95% of the negroes and 49% of white men examined were found to be suffering with this trouble. So great was the number that steps were taken at once to remedy the defect. Camp Dix, in New Jersey, became the center of this work, and five wards in the orthopedic department were given over to patients suffering with flat foot. This is the importance that army surgeons attach to the arch in the human foot. An extremely high arch at one time was considered a mark of royal birth. However that may be *we never see a person with a high arch who does not walk quickly, gracefully and without tireing readily.*

The joints of the body protect it from jars in many ways. If you hold a long pole in one hand and some one has hold of the other hand, if you strike a sudden sharp blow on your end, the person at the other gets the full force of the blow, but if instead

of a pole held a chain of several links, no amount of blows at your end would affect the person at the other. Just so it is with our joints. A blow on one of our fingers will scarcely be felt beyond the hand, but were the hand and arm one single bone, the force of the blow would be felt to the shoulder. This holds true all over the body while our joints add much to the efficiency of the body, they also play an equally important part in protecting it from injury.

At one time a child born with deformed bones, was considered a hopeless burden on its parents, and little attention was paid to straightening out the deformity. That is now all changed, and the orthopedic department of our large hospitals are crowded with seekers after straight sound bodies. *Massage is one of the means taken to loosen up stiff joints, humped backs, and lame feet. The bones are often treated under electric heaters. Then various corrective exercises are practiced by the patient.* Scarcly more than a mere suggestion of the work done can be given here. Dr. Adolph Lorens, of Vienna, Austria, came to America in 1904 and first demonstrated the benefits which could be gained from treatments. At present Captain Rolland Meisenbach, of Buffalo, N. Y., is the leader in the work among our new recruits. In passing it may be well to say that *the person who depends on arch support to correct broken arches is about as wise as the man who depends on a crutch to set a broken leg.*

Some of the causes of abnormal curves are: *unnatural positions either sitting, standing or walking, tight clothing and too heavy work while young.* Ill fitting shoes, French heels or standing too long on the feet are the main causes of broken arches.

Bones—Shape—Structure.

The bones in different parts of the body have a variety of shapes. The skull is made up of *shell-shaped bones.* In the fingers and toes are *small slender ones* and those in the *wrists and ankles are round.* The bones of the arms and legs are of course *long and somewhat cylindrical in form.* Perhaps the back bone itself is the most peculiar of all the bones. It is made up of a collection of *circular rings of bone.* Each little bone is very irregular

in shape and fits into its next door neighbor very intricately. A hollow cavity is left through the center for the passage of the spinal cord and for its protection.

Bones vary much in shape and size, but their structure is much the same. *They are covered with a tough membrane called the periosteum. They are hollow or spongy on the inside and hard and solid on the outside.* The long bones furnish the greatest strength in proportion to their weight. Solid bones would be rather too heavy for the body, and *all the bones are constructed so as to be light as well as strong.* It is said that the hollow spaces in the bones of birds are fllled with air in order to make them lighter for flying. The bones of short, square and flattened shape are spongy. This is true of such as those of the skull, wrists, and hips. The spongy places are filled with soft tissue called red marrow. It is very interesting here to mention the fact *that the red and white corpuscles originate in the red marrow.*

In conclusion, if one would be better informed he should make an examination of the bones of the skeleton, studying cross sections as well as sections made lengthwise.

When bones are to be used for fertilizer, the fat and gelatin are removed by boiling; they can then be readily acted on by the weather and will hastily decay. The oil and fat which they contain is used in the manufacture of soap and lubricants. Of course it must be understood that before the bones are used for fertilizer they are ground to dust. The valuable part, which is the fertilizer, is composed of phosphate of lime.

Composition of Bones.

It has been determined that *the bones are composed of animal and mineral matter.* The animal matter toughens them and renders them less brittle. The mineral matter consists largely of lime. This is gradually built into the bones from early childhood. In the bones of a child there is much more animal matter in proportion to the mineral than in the adult. Consequently its bones are not so easily broken. It is possible to remove the line from bone substance by soaking it in a weak acid. A bone so treated can then be very easily bent, although it will retain its general shape.

On the other hand, it is quite easy to remove the animal matter. Simply burn a bone and the animal substance will be consumed, leaving it much lighter and more brittle. Lime and chalk will not burn and so there is left the components that makes the bones stiff and firm.

Growth and Repair of Bones.

It should be stated that bone is a living tissue and *receive its food from the blood.* If some of the cells be left undisturbed, the bone will be reproduced. The end of a young bone may be removed and afterwards it will be reproduced. If the periosteum be uninjured, it will cause the formation of a new bone, because the periosteum helps to nourish the bones.

When a bone is broken, the cells are injured and blood vessels and nerves torn. Naturally such an accident is attended with much pain and suffering. The cells at once set about reproducing themselves and fill in the space with new connective tissue. The next step is the depositing of lime in the new tissue and this follows in a very few weeks. The union is then complete, but some time must pass before the bone is strong again. A fractured bone will generally heal within three to six weeks, but some times requires more time. It is said that in the temperate zones, bones reach their perfection in men between the ages of twenty and twenty-five, and very few changes take place from this age to fifty, and after the age of fifty they grow thinner, lighter and more brittle.

Purposes of Marrow.

There are two purposes of the marrow of bones—just as there are two kinds of marrow. In the long tube-like bones, such as the femur, we find the hollow part filled with yellow marrow, composed of blood vessels and fat. This is for the purpose of nourishing the bone.

The red marrow is found in the cavaties in the spongy parts of the bones such as the ends of the femur. *Recent investigations have proved that this marrow produces the red corpuscles found in the blood.*

Periosteum.

The periosteum is the close clinging fibrous tissue covering the bone. It is composed of connective tissue and blood vessels. This is seldom found at the ends of the bones, but is replaced there by the cartilage. In the periosteum, are the blood vessels which pass into the bone to supply it with nourishment. It grows closely to the bone but may be removed by scraping.

Joints.

A joint is formed where two bones unite. The surfaces which make the contact are covered with a layer of smooth, polished cartilage. This prevents jars and reduces friction. The joints that allows movements are covered with a synovial membrane. This membrane secrets a fluid like the white of an egg which moistens and lubricates the joints. If this fluid were absent, the joint would soon become so dry that it would creak. The bones are held in place by strong bands of tissue, called ligaments. They are able to stand a great strain without injury, but, besides these, the muscles that surround the joints help to make the bones stay in place. The shoulder joint is of such great importance that it is covered completely with muscles and ligaments which render it very strong.

Uses of Joints.

If one has ever seen a person with a stiff knee or elbow joint, he can readily understand the value of joints that nature provided for us. *If it were not for our joints every time we wanted anything from the floor the whole body would have to rest on the floor before we could reach it. If it were not for our joints almost all human action would be impossible.* If we but watch a group of acrobats a few minutes we can better appreciate the joints of the human body, for by training, they come to the point where the whole body is as supple as though no bones existed but rather that the body was a succession of joints. The writer a short time ago saw an Arabian acrobat who turned somersaults five times in succession, his feet striking the floor but once, and that at the third run.

Types of Joints.

There are movable and immovable joints. Some admit of a great deal of movement and others none. Between these two extremes are joints capable of various degrees of motion. A variety of names have been applied to the different kinds of joints. Some authors class them as flexible and inflexible, making the former include the joints of the limbs and the latter those of the head and trunk.

The joints of the skull are immovable. Some of the bones are joined together by cartilage during childhood, but later this hardens into bone. *The thick bones of the top of the skull are dovetailed together and cannot be separated.* They admit of very little, if any, movement. *Between the vertebrae of the back bone are pads of cartilage which admit of slight movement and reduce jars that might prove injurious to the spine.* The ribs are joined to the breast bone with cartilage, but this takes up lime and becomes bone in later life. All these joints may be classed as inflexible.

The hinge joint permits movement in but two directions. The joint at the elbow belongs to this class. If one were to look for other joints of this kind, he would find them at the knees. Can you think of other hinge joints?

Some joints of unusual strength are necessary. *The ball-and-socket joint fulfills this purpose.* In this kind the rounded end of one bone fits into the depression or socket of another. The bone with the rounded end can move freely in any direction, but the shape of the socket limits the extent of the movement somewhat. The shoulder joint is an example of a shallow socket, while that of the hip has a very deep one. These joints are strengthened by many ligaments and muscles.

There remains to be mentioned the pivot joint. The best example of such a joint is to be found where the head and atlas turn upon the pivot of the axis. This permits of the rotary motions of the head with which every one is familiar.

Ligaments.

The ligaments are bands of tough inelastic tissue. Their use is to hold the ends of the bones in joint and protect their movements. The ligaments are capable of withstanding great strain, but in spite of this they sometimes become broken or torn so that they will no longer hold the bones in their place and the bone is then said to be out of joint or dislocated. Some of the ligaments are as thin as tissue paper, while others are very thick.

Diseases and Deformities of Bones; Due to Infections, Malnutrition.

The bones are subject to diseases quite as much as any other tissue of the body. *Inflamation and even abcesses often result from bruises.* The bones become very tender and the diseased portion very painful. *Consumption of the bone is not an uncommon disease.* It is very difficult of treatment and is greatly to be dreaded. *Pieces of bone sometimes die,* and the periosteum will then form new bone. Generally bone wastes away more slowly than it is reformed. Bones are often broken, but may or may not become diseased at the point of fracture. The cells reproduce themselves and soon fill the space at the broken point. Then lime is soon deposited there to harden the place. Sometimes the bones soften; this results from an unhealthful condition of the bone tissue. *Rickets and felons are also diseased condition of bones.*

Some bone diseases are due to infection, such as tuberculosis and felon, while others are due to *malnutrition.* We have seen how the bones are fed by the blood vessels in the periosteum. Hence, if the blood is not pure and rich, we cannot expect the bones to be other than deformed or diseased. For this reason it is more often that we find bone disease in tenement districts. A lack of mineral matters such as lime is one source of small weak bones. For this reason, children should have plenty of milk, eggs, and butter. *Anything that impoverishes the blood interferes with bone growth.*

The preceeding pages will give us a definite idea of our skeleton, its parts, arrangements and uses. But the skeleton alone would be of little use to us. It must be covered with flesh, blood, and muscles.

Muscles acting with the aid of the bones produce motion. Muscles are therefore of great importance in our study of the human body and its relation to its environment. If we could not move, we would rank with but plant life.

All motion in the body is produced by muscles. Not only is this true in preparing and earning our food, but in chewing, swallowing and digesting it. *The muscles are the means of pulling the bones in any desired direction,* and when we consider the infinite number of movements the human body is capable of, we are not surprised to find that there are over five hundred muscles to perform this motion.

The contraction of the muscles makes it necessary that they be well supplied with fuel food. *Most of this is taken in the form of sugar and is burned in the muscles, producing heat.* When the surplus food is used up, a demand is made for more. The brain interprets, this request as hunger and we say that exercise has made us hungry. *The fuel is brought to the muscles through the blood.* When there is a demand for more, the nervous impulses quicken and the action of the heart and the circulation becomes more vigorous. Much heat is then distributed to all parts of the body. Every one is familiar with the fact that exercise increases the heat of the body. A man at work on a cold day will keep much warmer than an idle person, because exercise of the muscles produces *heat.* The burning of the fuel food in the muscle cells not only *produce heat,* but also gives rise to waste materials. These waste materials may be removed by the blood, and will if left cause poisoning. When they are not removed, soreness results. Hot water applied to the muscles will help them to get this poisonous matter away and thus reduce the soreness. Too much exercise may prove injurious, but the proper amount is beneficial.

Classes of Muscles.

Aside from the skeleton, the greater part of the body is muscle. It is said to comprise about one-half of the body weight. If you have observed the flesh of a slaughtered animal, you have discovered the dark red portion which we call lean meat. This is muscle.

Muscles are divided into two classes, *the voluntary and involuntary.* Voluntary muscles are under the control of the will, while the involuntary muscles are not so cotnrolled. To some extent we may control the involuntary muscles as in the act of breathing. The voluntary muscles are tied to the bones and thus make possible our many movements. On the other hand, the involuntary muscles are found in the walls of the hollow organs, such as the abdominal cavity.

Examples of the voluntary muscles are the muscles which control the arm and leg, the muscles that turn the head, and the muscles of the lower jaw.

Examples of the involuntary muscles are the muscles that control the heart, stomach, and other internal organs.

Shapes of the Muscles.

The muscles are of various shapes, as suited to the work they are to perform. The gullet is a *fleshy tube* of involuntary muscle. Some muscles, as the heart, are *hollow.* *Circular muscles* are found in the mouth and eyes. The diaphragm is a *broad, flat muscle,* being the broadest in the body. Other muscles are *long and taper at both ends,* as the muscle we use to cross the legs. Muscles change their shape, from normal when contracted or expanded.

Structure of the Muscles.

The muscles are composed of little bundles, each bundle made up of muscular fibres. If one should boil a piece of beef, these little bundles appear as dark red strings.

The structure of involuntary muscle, though different from the voluntary muscle is quite simple. *Little spindle shaped cells are held together by a glue-like substance.* A diluted acid will dissolve the glue and leave the cells separate from each other.

Attachment of the Muscles.

Perhaps you have wondered how the voluntary muscles are tied to the bones. *It is by means of tendons.* A tendon appears

to be a white cord of fibrous tissue and has great strength. If you look real closely at a tendon, you probably cannot tell where it leaves off to become muscle at one end and periosteum or bone at the other. A tendon runs in a groove lined with synovial membrane and thus works very smoothly without friction. The tendons are quite long, especially where the parts are slender; the fingers are supplied by tendons from the muscles in the upper part of the forearm.

Action of Muscles on Bones as Levers.

When we grasp a heavy weight in the hand and lift it, it is the biceps, a muscle of the upper arm, that does the work. This muscle is attached at the top by two tendons to the shoulder blade. The lower arm is used as a lever with the elbow as a fixed point. The slight contraction of the biceps has caused the weight to be moved a much greater distance than it contracted itself. This was accomplished by the co-operation of muscles and bones, and this is the service the bones usually render the muscles. They change a slow short movement into a long swift one. Though the biceps perhaps contracted no more than an inch, the bone moved a foot or more. *Thus when the muscles act on the bones as levers,* the bones greatly increase both the rate and range of motion.

Antagonistic Action.

Most muscles are arranged in pairs. The muscles that extend along the limb either straighten it or bend it. The former are called "extensors" and the latter "flexors." *When muscles cause such motion in opposite directions, they are known as "antagonists";* in the upper arm are the biceps and triceps.

Acquiring and Maintaining of Healthful Posture.

A flat chest and round shoulders does not so much indicate weak lungs as it does weak back muscles which support the body. These muscles have become weak from constant relaxation while at work. This deformity may result from rowing a boat, bending

over a desk, table or kitchen sink, or from anything which causes us to stoop over a good deal. It is as common among farmers as office workers, and is even less excusable. It gives one an awkward appearance and invites lung diseases. This may be overcome by special exercises which tend to strengthen the muscles of the back. Shoulder braces are of little use except as a reminder "to sit up." One must first learn self control and then acquiring of a healthful posture is easy. *In sitting one should sit back in the seat, with back straight. In standing, the chest should be out, hips back and head erect.* Many exercises help to acquire these postures, but constant care is the only thing that will help us maintain them. After a time they become habitual, then an incorrect position proves exceedingly uncomfortable.

Motion and Heat Result of Changes in Muscle; Muscles Require Oxygen and Food for These Changes.

Motion and heat are both forms of energy. They are but a changed form of energy generated by the oxidation of food stored in the muscle cells. This oxidation is as yet imperfectly understood, but we do know that it releases energy in the form of heat or motion. The greater the motion, the greater the heat, because of the greater amount of oxidation taking place. But these changes cause a poisonous waste to be formed which we now recognize as the causes of fatigue. These poisons result in a temporary paralysis of the nerves of the muscles but if the worker rests for a time the blood soon carries the poisons out of the system.

Since the amount of heat and energy we can expect from our muscles depends on the oxidation of food stored up in their cells we can see how very necessary pure fresh air and good healthful food are to muscular activity. A person deprived of pure air and wholesome food would soon be so weak he would be unable to perform work of any kind. The oxygen is carried from the lungs by the blood to the cells of the muscles where the change takes place.

Necessity for Circulation.

In order for motion and heat to be released from the muscles, it is necessary that the blood circulate. For two reasons this is true. *Oxygen must be carried to the muscle cell and this work is done by the blood circulating through the body.* The second need of the circulation is *to remove the toxins of fatigue which result from oxidation.*

Necessity of Physical Exercise.

The general health of the body depends much upon the exercise one takes. During exercise, the cells take extra food and increase their size and strength. Respiration, digestion, and circulation receive added vigor through exercise of the muscles of the body. Indigestion is often due to the lack of physical exercise. As to the kind of exercise one should engage in, it may be said that the one he likes best is the correct one. Games are more delightful than formal exercises and are likely to be much more enjoyed. For this reason a vigorous outdoor game is the very best kind of exercise. Walking and riding are also very good. Swimming is to be commended, because it involves the use of many muscles. Running races is good exercise. The importance of exercise should be clearly impresed upon every one. Fresh air and exercise together have furnished a cure in many cases apparently almost hopeless. Do not lose sight of the fact that games are perhaps the very best forms of exercises and that work ranks next. The gymnasium is, of course, good, but is not good for all cases. Special cases should be assigned to the gymnasium. Children should be encouraged in play ground games. It is indeed a poor teacher who cannot provide simple outdoor games for her children. Several good books on the subject may be had in the city libraries and almost any good book company publishes one or more of them.

The Blood.

Just as the bones are dependent upon the muscles for their usefulness, so are the muscles dependent upon another part of the

body—this is the blood. We have touched upon this topic in a preceeding paragraph. We will now study the circulation in more detail. We will see what the composition of the blood is, how it performs its works, and how it is renewed and freshened. Upon a good healthy circulation depends the entire well being of the body.

When we speak of the circulation of the blood, we mean the functions performed by the heart, veins, arteries, and capilaries.

Blood—Composition.

The blood is the means whereby the circulation is carried on. It is found in almost all parts of the body—the hair, nails, and cuticle excepted. The quantity found in various bodies differs. Some of our most eminent authorities place it at about one-thirteenth of the body weight.

It is composed of a thin, colorless liquid known as the plasma. This is filled with red disks or cells. These cells vary in size and shape, but in human blood are generally rounded at the edges and concave on both sides. Some authorities declare that from the size and shape of these disks they can tell with accuracy whether a given specimen is human or animal blood. Others, however, disagree and maintain that the cell shapes vary even in the same body. It is difficult to realize how very small these disks are until we consider it would require three thousand five hundred placed side by side to measure an inch, and sixteen thousand piled, one upon another, to measure the same length. Besides these cells the blood also contains many other substances. Albumen—the substance found nearly pure in the white of an egg—is always found in the blood of a healthy person as are also various mineral substances—such as lime, magnesia, iron, potash, phosphorus, etc. It has been stated by one author, that enough iron has been found in the ashes of a cremated body to form a mourning ring. The real composition of the blood depends largely upon the habits and physical condition of the person under consideration.

Necessity For Blood in the Body.

The uses of the blood are two fold: First, to build up the bones and muscles, and second, for oxidation. The first is accomplished by the plasma, which is rich in mineral matter for the

bones and in albumen for the muscles. The second, "oxidation," we know less about. The red disks of the blood are the air carriers. They contain the oxygen, so essential to all animal life. Wherever any manifestation of heat or energy is made, there oxygen is used. It not only tears down but actually consumes part of muscle and other tissue, much as fuel is burned in a stove. Just what changes take place in this process is not quite clear, and only this can we assert with assurance—oxygen disappears, carbondioxide appears, energy is released, and force is exhibited as motion, heat, and energy.

Where the Blood Must Circulate.

The blood must circulate in all parts of the body except in modifications of the cuticle. But *there are two regions where the blood can not be checked in its circulation,* for even a very short space of time without causing serious trouble, and *that is through the lungs and along the digestive tract.* The reason is obvious. The oxygen of the air is carried by the blood to all parts of the body, and the body cannot long do without this supply. Then, too, the blood enmeshes the digestive tract in a network of vessels, and so takes up, absorbs, and assimilates the digested food as it is ready for the need of the body.

This absorption is accomplished in a sort of osmosis fashion and is carried on the entire length of the digestive tract from the stomach on down, most being accomplished from the stomach and small intestines.

Gains and Losses of the Blood.

The blood in a capillary is separated from the living body cells by a wall so very thin that it offers no obstruction to the passage of oxygen from the red blood cells. When the blood gives up oxygen to the cells, it receives in turn carbonic acid gas, and various impurities. It takes but an instant to make the change. *The arteries are simply tubes which carry the blood to the capillaries, where all the work of nourishing the cells is performed.* For the sake of brevity, one may say in general that the

blood in its circulation through the body gives up oxygen and gathers up waste, but if one should trace a drop of blood from the time it left some certain point in the body until it returned to that spot, the changes would be many and varied. The capillaries around the stomach and intestines gather up the digested food, which, with the blood, is carried by the portal vein to the liver. When it passes through the liver, it is purified of some of the irritating substances it gathered from the food tube. When it leaves the liver, it is taken to the vena cava. Here the blood is found to be rich in food substances but poor in oxygen. This mixes with the impure blood brought back by the veins, is carried to the heart and then sent to the lungs. It is in the lungs that the exchange of impurities is made for oxygen. This oxygen is picked up by the red corpuscles and causes the blood to look red and is known as arterial blood. This rich, bright blood is then poured in the left side of the heart, and from there it is sent out over the body to build up and repair the waste and worn parts.

Functions of Corpuscles.

There are two kinds of corpuscles in the blood—the white and the red corpuscles. The white are supposed to be the scavangers of the system, destroying poisons and injurious foreign substances, which find entrance into the blood. The red corpuscles are the oxygen carriers of the blood, and have to do with oxidation of food. While we speak very glibly of this process, we really understand it very little. But we do know that if a person is healthy and strong, his blood will have a greater number of red corpuscles than the blood of a sickly person.

Clotting of Blood; Use.

When blood is exposed to air it thickens, coagulates, or as we say, clots. This is most important since if this did not take place, even a very small wound would cause us to bleed to death. When blood clots, the corpuscles lose their bright red color, a clear liquid called serum separates, and a white insoluable proteid, fibrous in nature, is formed.

Organs of Circulation. Blood Tubes, Names, Structure, and Locaton of Each.

The blood tubes of the bodies are the arteries, veins, and capillaries. *The arteries* are the tubes which carry the blood from the heart. With the exception of the pulmonary artery, all the arteries carry red blood. The ancients so named the arteries (aer—air, and teero, I contain) because after death they were always found to be empty, and were therefore supposed to be air carriers. It was left for Harvey in 1619 to discover the circulation of the blood, and therefore, the proper relation of arteries, veins, and capillaries.

The veins are the tube-like canals which carry the blood to the heart. They carry the dark venous blood. To this there is the one exception of the pulmonary veins.

The capillaries form a fine net work of tubes, which unite the ends of arteries and veins. They so unite with both these that it is often difficult to tell where an artery ends and a vein begins. So closely are they placed that we can not injure ourselves in the slightest way without injuring great numbers of them. It is in the capillaries that the blood deposits its oxygen and gives up its carbonic acid.

Structure and Location of the Arteries.

The arteries are composed of an elastic tissue. This yields at every heart throb, until the blood is again forced into them and on its way. This elastic tissue is of a very tough nature, so that it can withstand the heavy pressure of the blood when the heart sends it into them. After death, the blood leaves the arteries and accumulates in the venous system. The arteries are lined with a very smooth membrane so as not to interfere with the circulation. The arteries are usually located as far from the surface as possibleout of harm's way. In this way they are protected by muscles and bones. Most of them hug the bones and for the greater part they take the shortest routes and therefore lie mainly in straight or nearly straight lines.

Structure and Location of Venis.

Since the veins do not receive the direct heart pressure, their walls are thinner and not so elastic as the arteries. The veins at first are minute but gradually unite to form larger vessels until they finally form the two large veins, the vena cava ascending and the vena cava descending—one of these empties into the upper part of the auricle and the other into the lower. We can plainly see some of the veins just beneath the skin on the back of the hand.

Structure and Location of the Capillaries.

The capillaries are a system of very minute blood vessels which connect the end of the arteries to the veins.

Valves in the Veins.

For the same reason that we find valves in the heart we also find them in the veins. The valves in the veins are similar in structure to the semi-lunar valves of the heart, and are found more numerously in the lower extremities, for here the force of gravity would interfere and act in opposition to the current of the blood, were there no special provision to prevent this. There are no valves in the veins of the brain or lungs.

General Circulation of the Blood.

The time required for all the blood in the body to pass through the heart can be found only by estimation. It does not require near the amount of time that one would think it would. It would not be the same in all persons. The habits and physical condition of the person under examination would affect the time to a great extent. At every pulsation it has been found that on an average the heart discharges about four ounces through each ventricle. By a similar reckoning we find that it takes about forty seconds for the blood to make the complete circuit of the body. We know the heart beats seventy times a minute and about four ounces leave it at each beat. At this rate about two hundred eighty

ounces or seventeen pounds would pass through it in a minute, but the average person has but twelve pounds and this amount would make the circuit in about forty seconds.

The general circulation is sometimes called the systematic circulation while the circulation through the lungs is known as the pulmonary circulation.

Pulmonary Circulation of the Blood.

When the blood enters the veins from the capillaries, it has become foul with the waste of the body and must be sent to the lungs to give off its impurities and to receive oxygen. To reach the lungs, it is first poured into the right auricle, then passing through the tricuspid valve it empties into the right ventricle. From here it is driven past the semi-lunar valves through the pulmonary artery to the lungs. This artery divides and subdivides into small branches, until these form a network of capillaries in the lungs. In the lungs, the blood is separated from the air only by the thin walls of the capillaries. It is through these thin walls that the oxygen of the air readily pentrates to the red blood cells. The carbonic gas and moisture pass out into the air. From the instant of exchange, the blood which formerly was dark now becomes a bright red color, and is called arterial blood. From the capillaries in the lungs, the blood collects into the four pulmonary veins, and is then carried to the left auricle, forced past the bicuspid valve to the left ventricle, and from here it passes through the semilunar valves into the great aorta, which is the main trunk of the arterial system. When the blood leaves the left side of the heart, it is forced through the arteries and back by the veins and is carried to the right side of the heart where it is purified.

Portal Circulation of the Blood.

The circulation of the blood through the liver is sometimes called the portal circulation. The digested food and the blood from the digestive organs is carried to the liver by means of the portal vein. After the blood stays a short time in the liver, it passes into the current of the blood to the heart and then through the system.

Structure of the Heart.

The heart is the untiring little engine which propels the blood.

The heart is a hollow pear shaped muscle, about the size of the fist. It hangs just a little to the left of the center of the chest, with its point downward. It is enclosed in a loose sac of serous membrane known as the "pericardium." It may be likened very much to that old fashioned headdress—the cotton night cap —for in just such a manner is the heart enclosed in the pericardium. The walls of the heart are made of strong muscles, while within the heart are four chambers or cavaties.

Cavities of the Heart.

The two upper cavaties are called auricles and the two lower cavities are the ventricles. In an adult each cavity contains about a wine glass full. The upper ones derive their name—auricles— from the appendages on the side which have a resemblance to dog ears. The auricles and ventricles on each side communicate with one another, but there is no direct communication between the right and left halves of the heart. They are entirely distinct and perform different functions in that the left side propels the red blood and the right, the dark. Inasmuch as the cavaties fulfill different purposes—their structure is correspondingly unlike. The upper chambers are merely receptacles for the blood—the left, as it returns bright and pure from the lungs and the right, as it comes dark and foul from the circuit through the body. In these chambers, it is held, and given over to the ventricles as needed. The work of the auricle being so light, their walls are thin. But with the ventricles the case is different. These cavaties force the blood to all parts of the body—the left to the farthest parts, and the right back to the lungs. The left auricle must drive the blood much farther than the right, consequently it is much more stronger even than the right.

Valves of the Heart.

In every pump, there must be valves to keep the liquid from flowing backward. The heart is provided with these valves, two between the auricles and ventricles and two at the opening of the

arteries to keep the blood from being forced back into the ventricles when the walls are relaxed, and the chambers are opened after each beat. Where the veins empty into the auricles, no valves are found because none are needed. The auricles do not contract with much force, and, the natural tendency of the blood being to flow downward, there is little need for valves to prevent its return into the veins above. But with the ventricles, the need of valves is imperative. The ventricles must contract with sufficient force to send the blood to the farthest part of the body. The ventricles in contracting would force blood backward into the veins and auricles and on into the arteries. Then, when the heart relaxed, the blood would crowd back from both ways into the ventricles. This danger is overcame by the ingenious arrangement of valves, one being between each auricle and ventricle and one at the opening of the ventricle into the artery. With the exception of the valve which separates the left auricle from the left ventricle, all the valves have three flaps. The valves are so constructed as to permit the blood to pass in but one direction. Between the right auricle and ventricle, is the valve known as the tricuspid valve. Between the left auricle and ventricle is the bicuspid valve. This has but two flaps. In the passages from the ventricles into the arteries are valves known as the semilunar valves. Each is three little folds of membrane opening out in the direction in which the blood flows.

The valves are made of double folds of the delicate membrane lining the heart. This membrane is known as the serous membrane and is found in all parts of the body not exposed to external air. These folds are strengthened by fibers which lie between the folds.

Nerves to Regulate Heart Beat, Amount of Blood to Working and Resting Organs, Distribution As Affected By Heat and Cold.

Two sets of nerves regulate the action of the heart. One set from the brain and the other from the spinal cord. When one has been exercising physically, the spinal set start the heart to beating more forcibly and faster.

The action of the heart is much like that of suddenly squeezing a water soaked sponge. The veins pour the blood into the auricles. From there it passes into the ventricles. These then forcibly contract and the blood is sent on its way to all parts of the body. After the ventricles have emptied their contents into the arteries, the heart has an instant to rest. Thus, the heart works away at the rate of 100,000 beats per day. In all we might say that the heart works about one-third as much as the muscles. Of course, any one would think that after doing all this work it would naturally wear out, but it is a machine which constantly repairs itself. It is said by some authorities that in a natural life time it propels about a half million tons of blood.

Regulation of Blood Flow.

The regulation of the blood flow is controlled by the beating of the heart, while this in turn is more or less controlled by the brain. The heart action is not altogether dependent upon the brain, for the heart of a cat may be removed and yet will continue to beat, sometimes for hours. Nevertheless, the brain has the power of hastening or checking the heart's action. From the brain to the heart runs two nerves, which might be compared to telegraph wires. Over these, messages are constantly going which control our circulation. Yet this is done without our being aware of any change or without conscious violation on our part. Only one case has been recorded of a person who has been able to interfere with the beating of his heart. This notable exception was Colonel Townsend, of Dublin, who, after succeeding in stopping his pulsation several times, at last lost his life while doing so. At the wrist, we may feel the expansion of this, the radial artery, by the wave of blood forced onward by the heart. At the temple, the same pulsation of the temporal artery may be felt. In health, there should be from seventy-two pulsations per minute for a grown man, to eighty for a woman, ninety for a child of seven, and one hundred twenty times for an infant. This pulsation depends upon various conditions. Excitement or inflammation may increase them, loss of vigor will decrease them, while nearly every disease modifies them so that the physician may find in them an

indication as to the nature of a disorder. But the regulation of the blood does not depend altogether upon the heart action. The size of the blood vessels may be so changed by the brain that more or less blood will flow through. All the small arteries have small muscle fibres running around them. When these fibers contract, they narrow the opening, and lessen the amount of blood allowed to pass. All of these fibers are connected with the brain or spinal cord, and thus the amount of blood which flows to any organ may be controlled. If for any reason any part of the body needs more blood than another, it is not always necessary for the heart to increase its action. The nerves controlling the muscles around the blood vessels in that particular organ may relax and thus allow a greater flow of blood to that part. When any part of the body is actively at work, it needs greater blood supply, for the blood carries nourishment. The more strenuous the labor we perform the greater the blood supply needed. After a full meal, the stomach and intestines need a large amount of blood for their work.

Vaso Motor Nerves.

By means of the nerves from the brain, known as the vaso motor nerves, the small arteries in the intestines are made to relax, and allow the blood to flow through them more rapidly. Then the walls of the stomach and intestines become filled with blood and digestion goes on rapidly. Blushing results from a similar action of the blood vessels in the face, while a pale or pallid skin means contracted vessels.

When heat is applied the blood is drawn to the surface, the veins become congested and a rosy tint is noticeable on the skin. Or if nature wishes to cool us off, the blood is forced to the surface as in running and active sports, or in fever. Cold has the exact opposite effect. When one is cold the skin is pallid, the lips colorless, and the blood is held on the interior of the body.

Effects of Chilling Body Surface.

If the surface of the body is chilled, the temperature of the body as a whole may not be changed, but the blood will be driven

inward, perspiration ceases, the lips become blue, the skin somewhat numb, and the face pale. Sudden chilling of the body surface often results in cold, while extreme prolonged chilling will result in death.

Trace Circuit of the Blood.

When the capillaries empty the blood into the veins it is foul, and must be carried to the lungs to be purified. But it is first taken to the heart where it enters the right auricle, then flows into the right ventricle. Then the pulmonary artery carries it to the lungs. Here it is purified, and is then collected into the four pulmonary veins which carry it to the left auricle of the heart, from where it flows into the left ventricle. From here it enters the great aorta, then the arteries, then the capillaries, and finally back to the veins where the circuit begins all over again.

Lymph, Source, Use, Circulation.

The lymph is a thin, colorless liquid, and almost transparent This lymph circulates through the lymphatics like blood circulates through the veins. It arises from the fluid part of the blood which exudes from the capillaries, bathes the cells and tissues of the body, and, after feeding them receives their excretions, then passes on to enter the circulation. Some authorities describe the lymph as blood lacking in red corpuscles.

Circulation of Lymph.

The lymphatics are a set of tubes provided to take care of the lymph. The smallest lymphatics are much smaller than the smallest capillary, and their walls are so thin that it is difficult to see them even with a very high power microscope. They may be either on the surface or deep-seated. They are very numerous in almost every part of the body. They finally run into one another like little streams into a river. These finally all unite and empty into the thoracic duct, which is a tube about the size of a goose quill, in front of the spinal column. It extends upward and empties into a large vein on the side of the neck. For a man weighing about 150 pounds about six pounds of lymph is discharged.

Lymphatic Glands or Nodes.

At irregular intervals, the lymphatics open into spongy bag-like bodies, known as the lymphatic glands. These glands filter out all injurious matters to the system, while the cells of the glands destroy poisons. They vary in size from a wheat grain to a small nut. They may be felt in the neck, arm pits, and groins where they are often enlarged by disease.

Respiration.

We now see how various parts of the body are dependent upon one another. The skeleton serves the muscles, while the blood feeds the muscles. We now come to our next step or organs those of respiration.

Respiration may be defined as the function whereby the impure blood is converted into pure blood. At first sight we might think respiration was a very simple process, but when we take into consideration the object and the organs concerned, we soon find it is a complicated process. The main object is to bring the living cells and the blood in direct contact with oxygen, so that in the one case they may be purified and in the other that oxidation may take place.

Organs of Respiration.

The organs of respiration are nose, pharynx, larynx, trachea, and bronchi. Add the lungs and the red corpuscles and we have the respiratory system.

The Nose.

The nose is the first and outer part of the air tube. It is a double tube and is lined with mucous membrane. The nose is joined to the skull by small bones. The nostrils are separated from each other by bony partitions. Each nostril has its walls bent into curved folds, three in number, which run lengthwise in such a way that each tube is almost divided into partitions. These

folds have a two-fold object—first, to warm the air before it enters the lungs, and second, to filter the dust and other impurities from the air before it gets to the lungs. The sense of smell is located in the nose. The nerve of smell is called the olfactory nerve. The fine fibers of this nerve are distributed over the upper part of the mucous lining of the nose. The use of the sense of smell is to guide us when we select food, and also to warn us against bad air.

The Pharynx.

The pharynx is a muscular bag behind the mouth and nose, and leads to the gullet. From the nose the air is taken to the back part of the mouth, called the pharynx, then through an air tube in the neck, and is then carried to the lungs. The pharynx is lined with mucous membrane and supplied with a muscular coat. The pharynx is really another name for the throat, and both food and air pass through this organ. The air should always enter through the nose, so it may be properly warmed and cleansed. Just in front of the pharynx on each side is a fleshy body, usually about the size of an almond, and much this shape. These are the tonsils. Sometimes these bodies become diseased and it is necessary to have them removed. However, this should not be done unless it is quite necessary, for these bodies complete the work undertaken by the nose—that of warming the air before it enters the lungs.

The Larynx.

The larynx is a small, triangular cartilaginous box situated at the upper and front part of the neck. It is through this box that the air passes. The larynx is really the organ of the voice because across its upper part are stretched two thin elastic bands, known as the vocal cords. These can be tightened or relaxed at will, so that the air passing over them produces a sound called the voice. Any one can easily locate the larynx by placing the fingers on either side of the throat and then swallowing. The hard bunch which moves up and down is called the larynx or "Adam's Apple," as it is commonly called.

The Trachea.

The trachea or windpipe, is a tube which extends downward from the larynx. It is about four and a half inches long, and is composed of a number of rings of cartilage; they keep the trachea from going together. The trachea is lined with a mucous membrane. At the lower end the trachea divides into two main branches, called the right and left bronchi, one of which goes into each lung. Each of these bronchi divide into smaller tubes called the bronchial tubes, which pass through the lungs like the branches of a tree, and finally end in short pouches called air sacs.

The Lungs.

The lungs are the essential organs of respiration and by them the blood is purified and again made fit to use by man. They occupy the cavity in the upper part of the body below the neck. In spite of all their size they are very light in weight, those of the average person weighing about two and a half pounds. Because they are so light, the lungs of animals are often called "lights," and will easily float in water. In children the lungs are of a pinkish color, while in older people they are a drab color and many times dotted over with black spots. A muscle called the diaphragm separates the lungs from the lower organs of the body. The right lung is larger than the left lung and has three lobes, while the left lung has only two. Each lung is covered with a smooth, delicate membrane called the pleura. When this pleura becomes inflamed, it gives rise to great pain called pleurisy. The chest is also lined with this pleura and when we breathe the lungs expand and cause the inflamed pleura covering the lungs to press on the inflamed pleura lining the chest. The lungs will stretch like rubber bags when they are filled with air, and collapse when the air is removed. If we want good strong lungs, we should give them exercise for it is essential to them as any other organ of the body. We should form a habit of frequently drawing long, deep breaths, filling the lungs as full as possible, and then blowing out the air slowly and forcibly. Persons who live a quiet indoor life especially should frequently exercise their lungs in this way.

Functions of the Organs of Respiration.

The functions of the nose are to warm and filter the air before it is allowed to pass on into the lungs.

The pharynx further warms the air, while the larynx is the organ of speech. The trachea or windpipe conveys the air from the larynx to the bronchi.

While the bronchi are composed of hoops of cartilage much like the trachea, their use is quite different. The bronchi not only carry the air, but they divide the air currents into innumerable parts, and bring it in close contact with the blood in the surrounding blood vessels.

The lungs, which are composed of the bronchi, air sacs and blood vessels, are the means whereby the blood gives up its carbon-dioxide and receives in turn oxygen.

Lung Capacity.

When we breathe in all the air we possibly can, our lungs contain about three hundred and thirty cubic inches of air. When we exhale all the air possible from our lungs, we breathe out about two hundred and thirty cubic inches, or about a gallon of air. This leaves about two hundred cubic inches of air which can not be breathed out. With each inspiration about twenty cubic inches of air is taken into the lungs; you can easily see that with each inspiration about one-tenth of the air in the lungs is changed.

Respiratory Movements of the Diaphragm and Chest Walls.

Our ribs are not only covered with muscles, but are connected by strong muscles. They are so connected by these bands with the sternum in front and the spine behind that, when we inhale a deep breath, they are raised up toward the shoulders, the sternum is pressed outward, and the sides move outward. This is caused partly by the muscles which attach them to both sternum and spine, and partly by the muscles which attach them—one to another. The lower edge of each rib is in this way fastened to the upper edge of the one just below it. The chest cavity is also en-

larged, by the movements of the diaphragm. This, by contraction, enlarges the chest downward. This diaphragm is a strong flat muscle, with a raised center, from the sides of which strong muscles pass to the walls of the chest. This diaphragm separates the chest from the abdomen. As the center is higher than the sides, any contraction of the muscles will pull the center downward, and in this way the chest capacity is enlarged. This is just what happens at every inspiration.

In ordinary, quiet breathing the diaphragm is largely used, about one breath to every four heart beats. Scientists have pointed out that the breathing of women differs from that of men, in that it is limited almost entirely to chest breathing, and is due to their different manner of dressing.

Chest and Abdominal Breathing.

In studying this phase of the subject, Dr. Mays, of Philadelphia, made some very interesting experiments among the native Indian girls in the Lincoln Institution. These girls had not yet adopted the dress of the white woman. In all he examined eighty-two girls, among which were thirty-three full blooded Indians, five one-fourth, thirty-five half Indians, and two, three-fourths white. Seventy-five showed a decided abdominal type of breathing; three a costal type, and three in which both were about even. Those who showed the costal type came from the more civilized tribes and were partly white, while in no instance did a full-blooded girl possess this type of breathing.

All of ths leads to show that the abdominal type of breathing is the original way of respiration, and that to the so-called civilized dress is due the chest breathing.

In chest breathing, the air is driven out of but a very small portion of the lungs. The tiny air sacs located at the bronchi ends are not exhausted and inflated at each breath as they should be, and so furnish a ready breeding place for all pulmonary diseases.

Changes in the Blood in the Tissues.

We are taught that carbon dioxide is not formed in the lungs, but is merely given off there. We must look further back in the

act of respiration to determine its source. Many varied experiments have been made to show that most of the carbon dioxide is formed in the tissues of all parts of the body during the process of nutrition. Therefore, when the blood comes back from the tissues to the heart, it is carrying carbon dioxide instead of oxygen. Further experiments teach us that carbon dioxide is formed by the decomposition of the tissues, and then the oxygen is used by them to rebuild themselves. The food which we have eaten supplies the carbon which passes off as carbon dioxide. It has been stated by reliable authorities that in a day about one and a half pounds of carbon dioxide is given off by the body. Some scientists hold that the muscle has the power of taking up oxygen from the haemaglobin and using it along with raw material (food) as furnished by the blood. This forms a contractile substance and when it decomposes it sets free its potential energy. When the muscle is inactive, this process is gentle, but when the muscle is in action it becomes violent. Others hold that the change in the tissues partakes of a fermentive nature—that is, under the proper ferments, the substance breaks up into simpler products thus setting forth heat and force. This change is then followed by a second oxidation by the oxygen in the arterial blood, and in this case as in all putrefactive procssses, carbon dioxide and water are set free. However, theories on this point are many and conflicting, and—simple as this process seems and is—it lies hidden from us within the cell.

Effect of Respiration Upon the Blood in the Lungs.

The blood, in its passage through the lungs, undergoes changes which parallel the changes of the air when it has passed through the lungs. The most noticeable change in the blood is the change in color. It enters the lungs a dark purplish, almost black, when it leaves the lungs it is a beautiful bright red. Chemical analysis shows that this change is due to loss of carbon dioxide, and a gain of oxygen. This change is not very clearly understood, but it is known to take place in the red blood corpuscles. The coloring matter of these corpuscles is haemaglobin. It has been discovered that when this unites with oxygen its color

is bright red, and dark purple when the amount of oxygen is reduced. However, this does not explain much, and just where and how the transaction takes place, we do not know.

Effect of Respiration Upon the Air in the Lungs.

The air gives up its oxygen to the blood in the delicate cells of the lungs. If the air is examined when it enters the lungs and again after it has passed through the lungs, the amount will not be changed to any great extent but its composition will be greatly changed. It loses about one-fourth of its oxygen, gains about one-fourth carbon dioxide, gains more watery vapor, and besides contains a small amount of decaying animal matter. The watery vapor can be easily seen by breathing upon a window pane some cold day. We have all noticed that the air in a closed room soon becomes offensive when many persons remain in it for any length of time. This is caused by the decayed animal matter which has been breathed out with each breath. This is not only disagreeable to smell, but poisonous to breathe.

Digestives Organs.

The organs of respiration furnish fresh air to the body. But the body requires more than air to keep it functioning. Food is also necessary. The organs which take care of the food we eat and convert it into a condition capable of being assimilated by the body are known as the digestive organs.

Digestion is that process which food undergoes in order to be made of service to the body.

Process of Digestion.

The process of digestion is really two-fold. *In the first place, the nutritious portions are separated from the non-nutritious,* and then *secondly, these are made soluable, a condition in which they are fitted to be taken up by the blood and made of use to the body.* This two-fold process is known as digestion and *the organs which carry it on are known as the digestive system.* The tube in which these changes take place is known as the *alimentary canal.*

It is clear to all that bread and meat are both of great value in sustaining life, yet neither can be taken up by the blood and used for bodily nutrition. Each must be so changed that they may pass through the membraneous lining which separates the blood vessels and other vascular bodies from the alimentary canal cavity. In discussing the subject of digestion, a sharp distinction should be drawn between that and assimilation, which will be discussed later, but which is all too frequently confused with that process which food undergoes in the alimentary canal, and which is properly speaking digestion or the mechanical and chemical preparation of the food till it is ready for absorption and assimilation.

Organs of Digestion.

The organs of digestion are the *mouth, stomach, intestines,* and *their related glands,* which make up the alimentary canal.

The Mouth.

The mouth is the first organ entering into the process of digestion. Here the food is reduced to a fine condition and mixed with saliva. The grinding is done by the teeth, which, in the adult, are thirty-two in number. This grinding process has two elements of value—the food is reduced to a condition in which it is more easily swallowed, and makes it more easily mixed with the various digestive juices which are to act upon it. If we think how much more easily powdered sugar is dissolved than loaf sugar, we see how much more readily the food is sent to the stomach in a fine state will be digested. Prompt digestion of food is very necessary for if held in the digestive tract too long it may ferment and serious disturbances of the digestive tract ensue. For this reason, if for no other, it is highly important that our teeth are in good condition.

The Stomach.

The stomach is the second organ of digestion. When the food leaves the mouth it passes down a narrow tube, the esophagus, into the stomach. The esophagus consists of a tube with

muscular walls, lined by mucus membrane. The opening between the esophagus and stomach is known as the *Cardiac aperture,* while that from the stomach into the intestines is known as the *pylorus or gate keeper.*

The muscular coat of the stomach is made up of two layers—an outer longitudinal and an inner circular layer. The mucus membrane with which the stomach is lined is loosely attached to the muscular coat by a fibrous connective tissue. This is known as the submucus coat and contains the nerves, blood vessels and lymphatics that supply the mucus membrane. This mucus membrane is made up of innumerable small glands, packed side by side, and opening into the inner surface of the stomach.

After the food leaves the mouth, it is forced into the stomach through the esophagus; then from the stomach it enters the intestines through the pylorus.

The Intestines.

The third principal organ of digestion are the *intestines.* The intestines form one long tube and are divided into the *large* and *small intestines.*

The large intestine is much shorter than the small, but is so called because of its greater diameter. That part of the small intestine—about ten inches in length—which is immediately connected with the stomach is known as the *duodenum.* The rest of the small intestine is known as the *jejunum and the ileum.* The transition from the small to the large intestine is sudden, and to prevent food from being forced back into the small intestine by the action in the large intestine, there is a sort of lipped valve known as the *ileo-caecal valve.*

The large intestine is really divided into five parts, known as the *calcum,* the part which joins the large and small intestines, the *ascending colon,* that part which turns upward toward the stomach, the *transverse colon,* which carries it across to the left side of the body, then the *descending colon,* which carries it down to the *rectum,* which is part of the colon or large intestine which opens externally. The structure of the intestines is in the main much like that of the stomach—containing mucus and muscular coats, and like the stomach, is enveloped in peritoneum.

Alimentary Canal, Parts, Structure, and Movements.

The alimentary canal consists of the mouth, gullet, stomach, large and small intestines, ending in the rectum.

When a piece of bread is put into the mouth, it is caught by the teeth and tongue and chewed. It is then mixed with the saliva, and forced down the gullet, a strong tube, which by contractions and expansions carry the food into the stomach. This power of the food tube extends throughout its length. It is carried out by a series of circular rings of muscles bound together by other threads of muscles running lengthwise and all forming the muscular coat of the tube. By their contraction they squeeze the food along its way.

The stomach is a pear shaped enlargement of the canal, where certain juices are poured upon the food. The stomach is fitted with an especially delicate lining. It is comopsed of tiny living cells laid side by side like the bricks in a wall. These cells pick up and use all substances they need for ferments, acids, or alkalies. *This same structure called the mucus membrane continues throughout the food tract with slight variation.* From the stomach, the food passes to the small intestines, then into the large and finally the waste is expelled.

Glands; Location; Secretions.

While the first part of digestion—the mere mechanical part—is carried on by the muscular movements of the various organs, *the chemical part is brought about by the action of minute organs or glands located at various points along the digestive tract.*

The first set of glands which pour their contents upon the food are the *salivary glands, which act upon the food in the mouth.* These glands are divided into the *parotid, submaxillary,* and *sublingual glands* according to their location. The parotid glands are just in front of each ear, and the ducts leading from them pass along the cheek until it is opposite the second upper grinding tooth. The submaxillary and sublingual glands lie between the lower jaw and the floor of the mouth. The sublingual lie nearer the front than the submaxillary. Their ducts which open into the mouth lie just below the tip of the tongue. *The*

secretion of these glands is called saliva. This fluid is clear, containing about 99 parts water and 1 part solid matter. It it is estimated that the amount secreted by an adult is about one quart every twenty-four hours. Up until recently, the importance of the action of the saliva on the food eaten was overestimated and scientists now are prone to regard its action more mechanical than chemical since it reduces the food to a condition in which it is more easily swallowed. Its main chemical reaction is caused by a *peculiar substance known as ptyalin, which acts upon the starches in the food changing them to sugar.* However, much of the starch we eat is not changed into sugar until acted upon by the pancreatic juice in the intestines.

The gastric juice is the next juice that is poured upon the food. This takes place in the stomach. The mucus membrane lining of the stomach consists of a multitude of small glands, packed closely side by side. When food is taken into the stomach, the small arteries of the stomach begin to dilate, more blood is sent to them and it is from this increased blood supply that the minute glands of the stomach take the material they require for their excretion. The secretion thus formed is the gastric juice. Pure gastric juice is a clean acid fluid, largely water with an acidity due to hydrochloric acid to the extent of 4%. In addition, a small quantity of pepsin is held in solution. *Proteins are the special foods acted upon by the gastric juice*; the resulting juice formed is much the same and is known as peptone. This differs from all other proteins in that it is extremely soluble, and does not become coagulated by boiling as does the white of eggs and other forms of proteins. As far as we know, gastric juice has no chemical action on fats; its action on them being purely mechanical in that it breaks up the fibers enclosing them, thus rendering them more easily acted upon by other juices. Gastric juice has no direct action on the carbohydrates, other than that while the food is held in the stomach and surrounded by the gastric secretions, the saliva with which the food was mixed in the mouth has a chance to act upon the starches present and to change them into sugars. When the food has been passed on into the intestines, it meets several fluids, which are poured out

upon it. *The bile which is secreted by the liver,* and *the pancreatic juice secreted by the pancreas are the two chief digestive juices of this region.*

The pancreas is a flat narrow organ about six inches long, lying behind the stomach. It tapers to the left and ends above the left kidney. It has been compared in shape to a dog's tongue, and at its broadest end, like the root of the tongue, it bends downward. Here the duct leading from it begins and joins the bile duct just before it empties into the duodenum. In intestinal structure, it is much like the salivary glands. The amount of digestion performed in the small intestines is greater than in any other part of the canal and much of this work is done by the pancreas, one of the most powerful and active of all the glands. The amount of pancreatic juice secreted varies with the kind of food eaten. It is about 87.5% water and 12.5% solid matter.

While undoubtedly the main object of the pancreas is to secrete digestive juices, it has other important uses as yet not very well understood. *If the pancreas is removed from an animal, a great amount of sugar appears in the urine and the animal soon dies.* This in human beings is known as diabetes.

The bile is secreted by the liver and is one of the very important digestive juices. The liver is the largest gland in the body. It weights 3⅓ pounds and is a reddish brown color. With the exception of the under surface, where the various vessels of the liver make their exit, the surface of this organ is very smooth and even. It is located in the right side and extends a little below the ribs. The bile duct as it leaves the liver gives off a side branch to the gall bladder. This is a little dark green sac, where the bile is stored until it is needed for digestion.

The liver has three duties to perform—its secretion of bile being but one of them. It may serve as a storehouse for digested food where it is held till needed. It is also an excretory organ. As the blood passes through the liver, poisons in it are eliminated either by way of the bile duct and alimentary canal or by way of the kidneys and blood vessels.

The amount of bile secreted is irregular and like the gastric juice seems to depend upon the kind and quantity of food eaten. It is a golden yellow liquid, alkaline and bitter. It varies in com-

position from 82 to 96.5% water and 18 to 3.5% solids. Its color is due to the presence of a pigment, bilirubin. It also holds in solution certain salts of sodium known as bile salts. Its value seems to be twofold—to emulsify the fats, and to keep the bowels sweet and free from putrification. Its action on the fats merely serves to break up the fat globules into smaller bits, hence making an emulsion of them, in which form they are more readily absorbed or acted upon by the pancreatic juice.

In addition to the juices already mentioned, there are certain intestinal juices secreted by small glands in the walls of the intestines. These appear to be very important factors in digestion, but as yet scientists have not agreed upon their action, *some maintaining their action merely supplements the action of the other digestive juices, while others hold their action entirely independent and separate.*

Processes of Digeston; In the Mouth, Stomach and Intestines.

As the processes of digestion have been so fully treated in the former topics, it seems necessary to give but a brief account of them here.

When food is taken into the mouth, *it is chewed and mixed with saliva,* whose only action is to a limited extent upon the starches which are changed to sugar. The next step in digestion takes place in the stomach *where the gastric juice is poured out upon the softened mass.* Here the proteins are rendered soluable, and the whole reduced to a milky-like mass called the chyme. The next step takes place in the intestines where *the pancreatic juice—with threefold action—handles starches, porteins and fats and where the remaining fats are further emulsied by the action of the bile.* By the time the mass has reached the large intestine, it is much drier and more compact, possessing a disagreeable odor and containing refuse, germs and such food substances as have for some reason or other not been acted upon by any of the digestive juices.

Absorption.

Absorption is really the sequel of the digestive process. A little of the water with some soluble salts and sugar were absorbed directly in the mouth by the blood vessels. Poisonous substance may be absorbed the same way, as Prussic acid, for instance. A few drops placed upon the tongue will cause almost instant death, while none of it may have reached the stomach. But the absorption in the mouth is very little compared to that which takes place in the small intestine. In the stomach, a slight absorption may take place of a portion of the proteids digested there. Some of the starch changed into sugar by the action of the salivary glands may also be absorbed here. But like the digestion, most of the absorption takes place in the small intestines. *The process by which the liquefied food passes from the alimentary canal in to the blood is known as absorption.* This is accomplished in two ways—first by the blood vesels and second by the lacteals.

The inner membrane of the digestive tract is lined with a minute network of blood vesels, which absorb or take up certain of the food elements. The absorbing surface of the intestines if measured as a plane would measure about one-half a square yard. The mucus membrane is formed in folds which have multitudes of tiny projections called villa, which greatly increase its absorbing capacity. During digestion, they dip into the liquefied food and by means of their blood vessels, absorb its contents just as the rootlets of a plant absorb moisture.

Lacteals are the second means of absorption. Lacteals are a set of vessels found only in the small intestines. They have their origin in the villi, side by side with the blood vessels. While these two sets of absorbers run in different directions, their destination is for both, the right side of the heart. The lacteals receive their name from their milky white contents and all unite to form one tube—the thoracic duct. The lacteals are but one of a class of absorbents known as lymphatics. The fluid which circulates through the lymphatics not concerned in digestion is clear like water and is known as lymph. This is the watery part of the blood not needed by the tissues, and is being returned to the blood by the lymphatics or absorbents.

Assimilation.

Assimilation means the use of nutrients after digestion to the maintenance of the vital functions and to the upbuilding and repair of flesh and bone. These processes take place in the tissues, where the nutritive substances are carried by the blood. It is the capillaries that this exchange takes place, and here each tissue selects from lifeless material that which it needs and changes them into substances like themselves. This conversion of lifeless material into living tissue—as yet imperfectly understood—is known as assimilation. During sleep, seems to be the most favorable time for this to take place, for then the circulation is regular and slower, and the other functions have ceased.

WORK FOR THE SECOND, THIRD AND FOURTH QUARTERS.

With our study of the digestive organs, we have completed the review of the various parts of the body. In our second quarter we will study bacteria and disease germs, the third quarter being given over to general sanitation, while the fourth quarter will be a resume of the year's work special attention being given to foods and the five special senses—hearing, sight, smell, touch, and taste.

Let us now see how the world around us affects us and our bodies.

Note to the teacher—Each teacher must use her own judgment as to the amount of time she gives the above review. If the general facts of bodily structure are known, together with the parts and their functions little time need be given this. Then the rest of the quarter should be given special attention. It is suggested that it be handled from the project standpoint—each child making a booklet in which he copies material or pastes pictures upon the chosen subject. One may choose the subject, "Our Common Housefly," another may take the "Mosquito and its Relation to Health." Another may choose the "Cockroach." Others may take the subject of "House Pests and How they Spread Contagion." Have all the subjects relating to agents which spread disease. This prepares the way for the more detailed study of bacteria in the next quarter.

It seems well to here discuss in detail two of the chief carriers of disease—the fly and mosquito. Each may carry disease germs but in a different way. The fly transfers them by the hairs of his legs, while the mosquito harbors within her own body—the female alone is a blood sucker—hence is the one that carries malaria germs—the germs of the disease we know as malaria.

Tuberculosis and typhoid fever are perhaps the ones most liable to be communicated by the fly. This is because the germs of these two diseases are cast out from the body of the sick person —the tuberculosis germs in the spitum and the typhoid in the excrement from the bowels. If we ever have noticed the disgusting habit of flies crawling over such filth then alighting on a person's face, hands, or even on uncovered food, we readily see how the little pest may be the source of grave danger. No one would stay long in a house full of rattle snakes, yet they will sit unconcerned in a room full of flies, while one is frequently as dangerous as the other.

It has been only in recent years that there was seen to be a relation to such insects as flies and mosquitos and human health. People became ill, and various causes were assigned. The tubercular patient caught cold, the malaria victim slept in the damp night air, the typhoid case ate two many fresh vegetables, while the sufferer from a cold got his feet wet or had sat in a draft.

The practice of curing diseases by one method or another is as old as the history of the world. In 400 B. C. Hippocrates, the "Father of Medicine," put forth the idea that disease was caused by a wrong adjustment of the humors of the body. Later, in the eighteenth and ninteenth centuries, various physicial and chemical theories of disease arose. But *not till 1863 during the Civil War was it demonstrated that the disease was caused by planting in a healthy body a particular kind of micro-organism.* More than one hundred years before, this theory had been proposed, but no proof had been made. In 1683, Leewenholes, a Dutch lens maker, made a lens so powerful that he could see living things in scrapings from the mouth. Lenses were improved until 1786 a classification of bacteria was made according to their form. But it was 74 years later before the discovery was made that there was any connection between these living forms and diseases.

In 1860, Pasteur and Tyndall discovered it was these germs found in the air that caused decay. In 1863, came the discovery that anthrax in cattle was caused by these living particles, which they called bacteria. In 1882, Robert Koch first used gelatin as as the means of cultivating and studying bacteria. These culture media made it possible during the last of the nineteenth century

to separate and study bacteria. *This study resulted in finding that specific organisms cause specific diseases.* We now have certain proof that such diseases as whooping cough, typhoid fever, scarlet fever, and other kindred diseases are caused by the transfer from the body of a sick person or from some breeding ground to the body of another person certain disease germs.

To prevent the spread of diseases caused by micro-organisms, three things must be learned. *How these germs get out of the sick body; how long they live and under what conditions, and how they are carried to another body and how they enter it.*

Among the most common of communicable diseases are tonsilitis, diphtheria, colds of all kinds, typhoid, tuberculosis, diarrhoea, hydrophobia, boils, sores, abcesses, blood poisoning, pneumonia, whooping cough, measles, mumps, scarlet fever, small pox, malaria and probably rheumatism.

A clear distinction should be made between bacteria and protozoa. The former are vegetable micro-organisms while the latter are animal micro-organisms. Bacteria are not all of a dangerous sort by any means. Indeed they accomplish much good for us. They are especially useful in converting dead organic matter into soluable food for plants. Many cause fermentation and give us sour milk, kraut, vinegar, the taste to various cheeses, to butter, and to many other foods we enjoy. However some bacteria are harmful, and cause diseases. From your study of Agriculture what can you tell of bacteria and the clover crop uniting their efforts to build up worn out soil?

Protozoa are usually too tiny to be seen by the naked eye—usually consisting of but one cell. Many live in water, others are parasitic and cause special diseases as the malaria protozoa. They are usually divided into:

1. Rhizopoda.
2. Mastigophora.
3. Sporozoa.
4. Infusoria.

Life History of Malaria Parasite and Other Protozoan Disease.

In 1880, Laveran, a French army surgeon, stationed in Algeria, found in the blood of patients suffering with malaria, an organism now known as Plasmodium Malariae. This organism burrowed into the red corpuscles of the blood and there went to work. At periods of twenty-four hours it ripened a crop of spores, then burst out of the corpuscles and scattering through the blood and tissues of the body, caused the well known paroxysms attending malaria chill. If quinine is administered just before the spores ripen, it either kills them or prevents their sporulation.

This discovery was a new departure in science, in that it prover that *the organisms which caused malaria were animal rather than vegetable.* All the disease germs hitherto discovered had been of the vegetable kind. This was an enormous step in advance in that it paved the way for the discovery that a whole class of animal parasites cause numerous infectious diseases.

Among the most common of these diseases are: Texas fever in cattle, dourine in horses, the tsetse fly disease, the dreaded sleeping sickness, and perhaps small pox. The fact now seemed clear that it must be conveyed to a human body through the body of some other animal. Since insects are the only animals that bite human beings with enough regularity and frequency to cause infection, search was made among this group of animals.

In 1895, Dr. Renald Ross, of the Indian Medical Service, discovered and positively identified the plasmodium undergoing a cycle in its development in the body of a mosquito. Experiments were made on animals, but no infection followed the mosquito's bite, hence it was clear that the experiment must be tried on human beings. Volunteers were called for and in ten days eight-tenths of the victims bitten developed the disease. Not all mosquitos were found to be malaria carriers, only the Anopheles, and of these only the female. This is true because the female is the only one that bites and sucks blood. The way that malaria is transmitted is for a mosquito to bite a person suffering with malaria. This innoculates the mosquito which in turn innoculates the person it bites.

To get rid of malaria, then the first step is to get rid of mosquitos. This is not the impossible task it seems. Mosquitos have definite breeding places, and if these are destroyed the pest is destroyed. One good way to clear a pond of mosquitos is to stock it with small fish which feed upon the larvae or "the wiggle tails" as they are popularly called, and hence prevent their developing into mosquitos. Another way is to pour coal oil over small pools and puddles. This prevents the hatching of the mosquitos. Drain pipes, gutters, rain barrels, tin can dumps, and all such places should be inspected regularly to see that there is no stagnant water that may harbor the pests.

When the United States attempted to complete the Panama Canal, the first thing they did was to rid the zone of mosquitos for malaria had been the great foe of the French in their effort to put through the great undertaking. In waging this war on the insects, the health commissioners found out many interesting facts. One was that mosquitos never flew against the wind, and if the wind was blowing from the bank of the river on which they were camped, they could sleep without netting or other protection. Another discovery was that only the female was a blood sucker. And not all females were malaria bearing. If a mosquito alights on the back of your hand watch it for a moment. If the back of the insect is parallel with your hand it is of the genus Culex and is not a malaria bearing insect, but if the body is at an angle with the surface of your hand, the head lower than the body, then it is of the genius Anopheles and may give you malaria, if it has bitten some one else who had malaria.

In late years when there is little waste, undrained land, malaria is much less common than during the early days of the state.

Another enemy of man and one charged with a long list of crimes against human health is the common house fly. Unlike the mosquito the house fly cannot bite, hence can not convey disease in the way the mosquito does. Flies walk upon filth then crawl over food. Especially are flies dangerous around dairy barns, for germs deposited in warm milk breed and increase at an alarming rate. These when examined under the miscrope have

been found to carry millions of germs on their bodies. As their legs and feet and body are covered with tiny hairs, the germs and filth readily adher to them, and are as readily left on whatever they alight upon.

Physicians charge the fly with carrying typhoid fever, diarrhoea, dysentery, tuberculosis, diphtheria, small pox, and anthrax. Some doctors add poliomyelitis (infantile paralysis) but others dispute this, saying too little is as yet known about the disease to make any statement definite.

Perhaps knowing something about how flies develop and where they breed may make it easier for us to know how to combat them.

There are four stages in the life cycle of a fly. First there is the egg period, then the egg hatches into the larva, commonly called a maggot.This develops into an inactive stage called pupa, which in turn develops into the fly as we commonly know it. This cycle depends in length on various conditions, the chief factor being a warm, moist temperature. The average period is 10 to 12 days—while the lowest is about 8, and in cold weather, the longest period may stretch into weeks.

The eggs of a fly are long and cylindrical shaped. They are from four to five hundredths of an inch long, and slightly smaller at one end that at the other. They are usually laid in masses of about 120, and under favorable condition will hatch in about 24 hours into maggots.

The maggots are transparent objects when first hatched but later become opaque and cream colored. They live in this state from four to five days, the time depending largely upon the food supply. When ready to pass itno the pupa stage, the contract within their skin, and become dormant. This stage lasts four to five days sometimes less, but under unfavorable circumstances as during the cold of winter may continue several months. When the fly emerges from the pupa stage, it first dries its wings, stretches its legs, and is ready to begin the life cycle all over again.

The average female fly lays two sometimes four sets of eggs. Then when we figure that there are from seven to fourteen gener-

ations each season, we can readily see how fast they multiply. One fly may have several millions of descendants by the close of the year.

The question then comes. How to get rid of them? The way is simple—keep everything clean and there will be no flies. Keep the farm clean, keep houses, yards and barns clean, and the fly will disappear like snow in August. There are three chief breeding places for flies—manure piles, open water closets, and garbage pails. The first two are primarily the sin of the country, while the latter may be.

New York has so largely settled her fly problem that few homes bother with screens. There are practically no barns, garbage is collected in closed wagons every day. All water closets are inclosed—the result is a nearly a flyless city.

Manure is the favorite breeding place of flies. Around barns it is especially dangerous for often the milking is done there.

Many attempts have been made to secure some simple effective way whereby manure piles will cease to be the breeding places of flies. Various compounds have been tried but as manure is one of the most valuable fertilizers, some method must be used that will not impair its usefulness. Another thing must be considered. Because of chickens and other fowls which have access to the refuse, no poisonous chemical is safe to use. Powdered helebore is now considered the most satisfactory agent. The helebore is made into a solution of one-half pound of powder to ten gallons of water. This is stirred and allowed to stand for twenty-four hours. For every 1¼ cubic feet of maiure 1¼ gallon of the solution should be sprinkled over the manure.

Borax was found very effective in destroying the maggots, but proved harmful to plant life, if the manure was used later as a fertilizer.

A mixture containing one-half pound of calcium cyanide and one-half pound of acid phosphate added to each bushel of manure proved very destructive to the maggots, and also was valuable in that it added nitrogen and phosphorus to the land over which the manure was spread. Many other solutions have been tried out by the government but have proven either ineffective, poisonous, or two expensive for constant use.

But we must not expect the farmer to do all the fly fighting. Every city house wife should be responsible for her own home, back yard, and especially her garbage pail. There are many pails on the market that are fly proof. Others have fiy traps in the lid that catch and keep all flies from the pail. A dirty housekeeper will always have a garbage pail swarming with flies. Not long ago a dainty little housewife boasted she could carry her daily garbage to the opera in her hand bag and no one would be any wiser. An examination of her garbage pail bore out her statement. It was a galvanized can, with tight fitting lid, painted inside and out with several coats of white paint. Each day the pail was lined with a clean newspaper, and the garbage placed on this. Nothing but dry garbage went into the pail. The rest was sent down the kitchen drain, then followed by hot water and some strong washing powder. This little housekeeper had no fly problem—since she left nothing out to attract them, the flies went where food and shelter was more abundant.

Fly traps are easily made. In many cities the boy scouts have taken it upon themselves to make and supply traps to all who will use them. In a school where manual training is taught, the making of these traps may prove a most interesting bit of work. Many states as well as the United States issue bulletins describing how such traps are made and may be had free if written for by a student.

Besides the fly and mosquito there are many other bugs, insects and small animals that are hostile to the well being of man. These have been treated more fully under science and agriculture than they can be here. Among them are the various kinds of ants, roaches, gnats, fleas, lice, bed bugs, rats and mice. Like flies, these pests are most effectively combated by complete cleanliness.

When we come to another division of animal life hostile to man, the situation is different. In this class we find the various worms, bugs, beetles, aphids, flies, and other insects which prey upon food intended for human consumption. Every garden, orchard and timber tract will yield its quota of insects seeking to

devour the plants we find there. These pests have been treated fully in the first quarter of the science and argriculture and the student is referred to the work as given there.

In the same quarter we found that not all insects were injurious. Some animals as the bee and silk worm have great commercial value. Japan's position among the great powers is due largely to her vast hords of silk worms that produce the finest cocoons in the world.

Among the beneficial insects also we must include the lady bug, or lady bird beetles, dragon flies, ets. These prey upon dangerous insects and help man in his fight to eradicate them.

Each child should famalarize himself with these beneficial insects so that he may spare them whenever and wherever he can.

Man's Dependence Upon Small Things.

While man stands at the head of the animal kingdom he by no means is independent of the lower members of his kingdom or even the vegetable kingdom. He is dependent upon both for his food and shelter, and anything which threatens either, interferes with his well being. Likewise is he dependent upon these kingdoms for his health and happiness. We have seen how bacteria and protozoa are almost everywhere. Some are beneficial ,some —as far as is known—are neutral in their activity to man—others are frankly dangerous enemies.

Our next quarter will be taken up with the more scientific study of bacteria, where they breed, how they cause disease how they are scattered, and various diseases which they cause. The third quarter is given over to sanitation and the combatting of disease.

SECOND QUARTER.

DISEASE GERMS.

Bacteria, Size, Form, Rapidity of Multiplication.

Bacteria—At the present time there is much study and discussion about bacteria. While there is much that we can not understand, for sanitary reasons it is worth while investigating the subject.

The word bacteria comes from a Greek word meaning "little sticks". It is difficult for us to think of bacteria as little sticks when they are so tiny, but that gives us the original meaning of the word. Bacteria, in reality, are very small one-celled plants and can be seen only through a microscope. Notice they are plants rather than animals. We can not escape bacteria for they are all around us—in the air, the soil and the water and are also found in living animals and plants. Fortunately many of them are harmless and go their own way and leave us alone. There are some, however, that we do fear and they are called disease germs. We cannot get away from them but only hope to prove stronger than they. Scientists know of over 1500 different kinds of bacteria but only about seventy grow in our bodies and cause disease.

Size—It is almost impossible for us to imagine the size of bacteria. They are the smallest living things. Some are so small that they can not be seen even with a microscope. It is said that thousands of them could find standing room on the point of a needle. Some are not more than 1/500,000 of an inch in diameter, if we can imagine such a measurement. A drop of water would make a swimming pool for an endless number.

Shape—Bacteria differ greatly in shape. Some are round like a ball, some slender rods, and others of spiral shape. They appear to be colorless sacs made of a clear substance, with no appearance of root, stem, or leaf as you usually see in plants.

Rapidity of Multiplication—Bacteria multiply very rapidly and sometimes a single bacteria in the morning will have millions of decendents by evening if they are not hindered.

There is a center to each germ. Under favorable living conditions the germ lengthens out and breaks into halves, and each half becomes another germ. As these grow they continue to divide into two, sometimes as frequently as once in twenty minutes. Two or three generations may be formed in an hour. They do not develop as rapidly as this at all times as conditions are not always favorable for their growth, but you can see the possibility of the development.

Spore Formation. Their Importance.

Certain bacteria, in reproduction, come to be known as spores. They are not as active in production as other bacteria, and some, known as sleeping spores, do not develop for a long time.

Bacteria are reproduced by a cell becoming longer until it finally divides into two new cells which go on dividing. Sometimes there is an irregular cell division and spores are formed. They differ from the regular bacteria in various ways. Most bacteria must have favorable conditions such as food, heat, and moisture to live but spores live under most unfavorable conditions. Spores often times stay in the body of their parents but are not really a part of the parent. When they are given off they soon become cloudy and a covering appears. In a short time the spore is enclosed within a heavy wall. This remains as it is for an indefinite time when conditions become favorable and it then produces a cell like the one which formed it.

Bacteria which produce spores are much harder to kill than others. When bread molds, the tiny black specks that appear on the top of the bread are spores. They are light and easily blown about and when they fall on a place favorable for their growth, they increase.

Disease Germs, With But Few Exceptions, Do Not Produce Resistant Spores.

Disease germs, for the most part, do not produce spores. If they did, our chances for living would be much less hopeful than

at the present time. Spores offer such great resistance and live such a long time before developing, that if they caused disease, we would have much to fear from them.

There is a disease, called Anthrox that is caused by these bacterial spores. It is found among both men and animals, but more frequently among animals, and sometimes causes death to many in a very short time. If the body of an animal that had the disease is allowed to decay, many of these spores are formed that can lie for a long time and then when they are taken into the body of another animal, begin at once to grow.

This shows us the danger if spores were common among disease germs.

Useful Bacteria, Such as Those That Produce Vinegar, Kraut, Sour Milk.

Bacteria is both useful and harmful. We are apt to spend most of our time and thought on the harmful kind and forget, that as in most things, there is some good to be found. Bacteria if not bothered, destroys all dead things. If it were not for this, there would be an endless accumulation of undestroyed waste matter about us. From the largest tree that falls to the smallest animal that dies, the bacteria cause decay and thus disposes of the tree or animal and enriches the earth. There are some plants that require food which is supplied only by bacteria in the soil.

Bacteria is also useful in food. It is true that it causes much food to spoil and become unfit for use but on the other hand, it adds to the taste of some food. Souring is a bacterial process. We cannot easily make butter from sweet cream. The bacteria sours it and then it can be churned. It is found that certain kinds of bacteria in the fat add to the flavor of the butter. Cheese depends for its taste and odor upon bacteria and mould. Some kinds of the stronger cheeses are placed in moist cellars to allow this bacteria to grow. Limburger is allowed to go through this process for four or five weeks and comes out with the not-to-be-forgotten odor.

Fruit juices will ferment, through the influence of bacteria and then turn to vinegar. The "Mother of Vinegar" is just a

mass of bacteria. A similar fermentation process causes shredded cabbage to become sauer kraut.

We can see the value of bacteria in foods as the butter, cheese, vinegar, etc., could not be produced without them and these foods, especially butter and cheese are wholesome, nourishing foods.

It is interesting to note that freshly churned butter contains a large number of bacteria. The next day it contains only about half as many and each day the number decreases.

Harmful Bacteria Such as the Disease Types and the Kinds that Destroy Foods.

It is interesting to study the uses of bacteria in producing butter, vinegar, cheese, etc., but probably if that were the only use, we would not know much about bacteria for it is the evil that it does that causes men to study into the subject that we may be able to combat its destructive work.

The two general classes of harmful bacteria are *those that cause disease* and *those that destroy food.*

As was said before there is a very small proportion of bacteria that cause disease and we are rejoiced at that, but those that do cause disease are much to be dreaded.

There are two kinds of bacteria, those which derive food from decaying animal or vegetable matter and those which inhabit another organism. The latter are called parasites. Nearly all bacteria which produce disease are parasites. We usually call them disease germs. Germs cause disease by entering the body and producing a poison or toxin and these poisons, given off by the germs, cause the disease. So we may say that germs cause disease indirectly. We used to have the idea that diseases were inherited but since germs were discovered we know that what is inherited is the weakness of the body to kill the germs that enter our bodies.

Bacteria that Destroy Food.

If it were not for this bacteria, food would keep indefinitely without change. We can't get away from these little plants and when food is left unprotected, bacteria begin work at once. We

have discussed the way food can be preserved but it is not possible to preserve all kinds. We can do much towards keeping food, however, by being sure our hands are clean when handling it and by having it in clean surroundings.

Bacteria and the Teeth.

Regular habits should be formed in the care of our bodies but probably there is no regular habit that is of greater advantage, from the health standpoint, than the habit of brushing our teeth regularly. For two very good reasons, we should brush our teeth the first thing in the morning and the last thing at night—for comfort and for health. Once we have formed the habit of keeping our teeth clean, if we neglect them, we can fairly feel a coat of film on them.

A very good breeding place for bacteria is teeth that have not been brushed and are decaying. When we eat, particles of food get between the teeth. These particles stay until they are removed. Bread and crackers and other starchy foods are bad about lodging in the teeth. Bacteria begins to work on these particles at once. The particles turn sour and an acid forms which causes the teeth to decay. The process is similar to the souring of milk. This acid acts on the teeth at once. It is difficult for the acid to act on the hard part of the teeth and it takes time but if there is a cracked or broken place in the teeth, it is much easier for the acid to do its harmful work.

Material from decayed teeth or from pus cavaties around the roots, may cause serious trouble.

If the teeth are properly cared for, the good health of the body will be greatly increased and on the other hand if the body is kept in good condition, the teeth benefit from it.

Knowing that bacteria will thrive in the moist warm food left between the teeth, we can easily see that the good care of the teeth is most essential.

Agents That Kill Bacteria. Open Flame, Hot Water, Sunlight, Long Drying, Chemical Disinfectants.

While bacteria is all around us and we are not able to get rid of them, there are agents such as open flame, hot water, sun-

light, long drying, and chemical disinfectants that do destroy them. We will discuss each of these agents briefly:

Open Flame.—Bacteria are particular in that they adapt themselves to conditions around them. Each kind seems to have its favorable temperature in which it grows best. None are capable of withstanding extreme heat. For this reason the open flame or fire is useful in extremely contageous diseases. Everything used by the patient that can, should be burned, and in the case of such diseases as tuberculosis, paper napkins can be used and burned so there is no chance for the spread of the disease germs.

Hot Water.—When a person is sick with a contageous disease, his dishes should be washed in boiling water. All bedding should be washed thoroughly and some disinfectant used in the water. The bedding should then be allowed to hang in the sunlight for some time to make sure it is perfectly free from germs. Hot water and soap are now used to a great extent where chemicals formerly were used.

Another important use of hot water is with dishes that have been used for foods that were spoiling. These dishes should be thoroughly scalded with hot water before using again.

Sunlight.—Direct sunlight is the most powerful known agent in killing bacteria. It kills the bacteria which cause many of the diseases of man. In the sun light are those ultra-violet rays which kill bacteria as soon as they fall on it. We can realize how powerful these rays are if we hang a colored dress on the clothes line directly in the sun. If the dyes are not especially good, it is but a matter of a short time until most of the color has left the dress.

People, in ordinary health, need this sunshine. If you have been housed up for a while because of rainy weather and the sun comes out and you take a long walk, you come in feeling much better. People whose work keeps them in the house most of the time would be in much better health if they could get out into the sunlight for a few minutes each day. If our houses are built so we can admit plenty of fresh air and sunlight, we have gone a long way towards good health.

Long Drying.—Water is so essential to the growth of bacteria that if it is taken away, vital processes cease. In part of the country where it is very hot and dry in the middle of the day, meat is hung up in strips and allowed to dry. Germs are present in the meat at first, but the germs are unable to work when there is lack of moisture and so much heat, and in a short time the meat is preserved from them. This drying reduces the bulk of the meat because the water is taken out but it also preserves it so it will keep, which is a great necessity especially if ice can not be had.

Milk, fruit, meat, and vegetables can be preserved in this way, but the work must be done in hot germ free air.

Chemical Disinfectants.—Chemical disinfectants are used widely but are the ones that require the most caution. Sometimes chemicals are used to preserve foods as milk and canned goods, but as a rule if the chemical is strong enough to preserve the food and kill the bacteria, it is not a good addition to food. Many times we use soap, water, fresh air and sunlight in a sick room where formerly we felt we must use chemicals. In some cases such as smallpox and infantile paralysis, chemical fumigation is necessary.

Antiseptics Simply Prevent Bacteria From Developing and the Same is True of Such Preservatives as Salt, Sugar, and Vinegar.

An antiseptic is anything which destroys the germs of disease or restricts their growth. These are used where there is the danger of too much bacteria being developed. All cuts, even small ones, should be treated with an antiseptic to prevent infection.

In another way salt, sugar and vinegar preserve food from being destroyed by bacteria.

Salt has a great attraction for water. We can easily understand this when we attempt to get salt from the salt shaker in damp weather. Bacteria contains little salt and a great amount of water. When the bacteria are placed in salt, the salt tends to draw the water through the walls of the bacterial cell. There is a slow passage of salt into the cell and as a result the bacteria

simply dries up and is extinguished. Strong sugar solutions are even more powerful in drawing water from bacteria. Honey resists these microbes almost indefinitely. Years ago it was found that sugar, added to fruits, helped to preserve them and today we add it to our preserves and if properly cared for they keep indefinitely.

Vinegar destroys the germs in food and so we find salt, sugar, and vinegar three good preservatives.

In order to preserve food, the bacteria must be destroyed and the food protected from other bacteria.

Resistance of Spores As Compared With the Actively Growing Forms of Bacteria.

Bacteria cannot make their own food, but get nourishment from foods that are ready made such as milk, meat, fruit, vegetables, etc. As is stated above, bacteria must have the right food, heat and moisture to live and produce other bacteria. When conditions are favorable they multiply rapidly but when food is scarce these cells do not divide to form new ones but many of them develop spores in themselves and when the bacteria die, the spores are set free. There is enough of the vital substance of the germ in the spore so that life is just maintained. A dense membrane is formed around it and the fact that there is very little moisture contained in it, increases its resistance. Spores can resist drying, chemicals, intense heat and all disinfectants. Under circumstances when bacteria would die, spores live on. It would be most disastrous to us if spores were disease germs for with their great resistance, disease would be spread in every direction.

Eighth Grade Pupils Should Understand these Organisms.

The eighth grade pupil should have a simple, yet definite, idea of the real nature of these organisms.

Eighth grade pupils are not old enough to take up a technical study of bacteria and profit by the work but they are old enough to have a simple yet definite idea of the real nature of these organisms. They should know what bacteria are, what they do

and the difference between the harmful and the useful types of bacteria. The eighth grade pupil should know that while there are many bacteria that are harmless, there are a few that we call disease germs that we must guard against.

Study of Bacteria Through the Microscope.

If a compound microscope can be borrowed, it will add to the interest and value of this work for the pupils to see bacteria as they appear in some decaying substance such as broth or stagnant water.

In much of our work in the study of science, we find that apparatus is absolutely necessary. We may read about things that can be done in laboratories but that means so little to us many times. If we can actually see experiments worked out, we understand so much more about them. A compound microscope is not an instrument that can be had in every school but if one could be borrowed it would add much to the interest and value of the work in the study of bacteria. We can show the pupils a small bowl of stagnant water and tell them that there are thousands of bacteria in it. It would take a rather vivid imagination to picture these bacteria to their minds but if they could actually see the bacteria through the microscope, it would make a deep impression upon their minds.

We could show the pupils a piece of moldy bread and explain the different stages of bacteria development but if they could actually see the bacteria, the whole process would be real to them. We are all familiar with the simple microscope or magnifying glass as we call it. A compound microscope works on the same principle but has more than one lens and is much more complex and powerful. A mirror is used to reflect the light and very tiny specks can be seen through it.

Experimental work could be made both interesting and valuable if a compound microscope could be used in the study of bacteria.

Experiments Are Worth While.

Simple experiments are suggested. A few will be given that could easily be used with the pupils.

Experiment to show the growth of bacteria. In this experiment be sure that *all* the dishes have been *boiled.* Boil a potato and with a sterilized knife and fork, lift it from the kettle, cut in halves and place on two saucers. Place over one half a tumbler but before covering the other half of the potato with a tumbler, place a drop of drinking water on it. Allow the two to stand and watch for the bacteria development on the potato with the drop of water.

An experiment to test the cleanliness of milk. Heat a pint of milk in a double boiler. Dissolve a junket tablet in a tablespoon of warm water and add to the milk when the milk is heated to body temperature. Thoroughly mix the milk and junket tablet and then let it stand until thick. Pour off all whey and when the curd is compact, cut it with a knife. If the milk used does not contain many bacteria, the curd will be smooth and rather solid, but if it is spongy then many bacteria are present. Take a tablespoonful of the curd and place it in water. If the milk is fairly clean it will sink but if it floats, the milk is not fit to be used.

An interesting experiment to show that it is not easy to detect filth in milk, is to put a quart of milk in a glass jar. Put into this a tumbler of thin mud and stir it. The mud does not change the appearance of the milk.

Put several thicknesses of paper in a saucer. Wet them and put on them a slice of bread. Scatter over the bread some dust, cover with a saucer and set away. Keep the bread moist and see the condition of it in a week's time.

Germs Other Than Bacteria, Such as Those That Cause Malaria.

Bacteria are one-celled plants and protozoa are one-celled animals—all are visible only through the microscope. We have just been studying bacteria and go to the study of protozoa because they are the germs that cause malaria. One rather interesting thing in connection with the two is that, for the most part, drugs are used effectively in diseases caused by protozoa while in the case of bacteria, our own body tissues have more force in destroying them than drugs do.

In malaria, the germs live in the red corpuscles of the blood and are from what we call the malaria mosquito.

This malaria mosquito is different from our ordinary mosquito. It never travels far but clings to the weeds and grasses near where it hatches. The mosquito has a long snout which it inserts into the skin of people and sucks out the blood. As the red corpuscles of the blood are too large for the mosquito, it injects its saliva into the blood to break up these corpuscles. As it does this it injects the malaria germs into the person. This germ goes right to the red corpuscles and begins to grow. These germs grow very rapidly. They destroy red corpuscles and begin work on the internal organs, and in a short time the patient begins to chill. Malaria is a disease which takes one's strength. It rarely causes death but just keeps people sick. Many times people are just sick enough so they can work but not do as much as usual. However, malaria shortens people's lives because the germs give off poisons which wear out the organs of the body, sooner than they otherwise would.

These microbes in malaria are in the blood of the person and so can be spread only by the mosquito so that the essential thing is to do away with the mosquito. To do away with the mosquito is to do away with all breeding places. We must not allow pools of stagnant water to remain. A tiny puddle of water is sufficient for the female mosquito to lay her eggs and mosquitos develop rapidly. The mosquito lives in the water but it must come to the surface for air. If kerosene is put on the pool of stagnant water, is shuts off the breathing places, and the mosquito dies.

People who live in districts where malaria is common should be sure their houses are carefully screened and that the breeding places of the mosquito are destroyed. Then the danger from the disease is not very great.

Parasites.

Parasites, as tapeworms, trichina worms, and intestinal worms that may gain entrance to the intestines through poorly cooked meats or from surface water cause disease.

The protozoa which cause malaria also cause worms. All meats contain disease germs. Pork especially may contain worms called trichinal and the intestinal parasites. Both beef and pork may contain tape worm. If meat containing these germs is not cooked, these animals get into the body but thorough cooking makes the meat safe.

Tape worms fasten to the walls of the intestines and live there, growing on the food meant for the person until they become long worms, shaped like tape. The young trichinal make their way through the walls of the intestines and enter the blood. The blood carries them to the muscle cells where they work their way in and destroy the cells.

Animals to be killed for meat are usually inspected but there are always dangers and the safest way is to be sure the meat we serve our families is thoroughly cooked and it is wise not to serve it too frequently.

While these germs do not grow very much in fruits and vegetables, they may get on them so the safe way is to wash all of the fruits and vegetables thoroughly.

How Germs Cause Disease—Growth of Germs in the Body.

Now that it has been definitely decided that germs cause disease, we are interested in learning *how* germs cause disease. While germs are everywhere around us, we know that we are safe so long as they stay on the outside. Only when they are taken into the body, are they dangerous to us. From the standpoint of good health, we should know something of their growth in the body. There are various ways in which they may enter but usually through the mouth or nose, through cuts or breaks in the skin, through drinking water or milk that is not pure, through food that contains germs or by mosquitos or flies which carry these disease germs to the body.

Germs do not provide their own food but have a way of getting food from their surroundings, so that when they enter the body, they at once find suitable food and grow and multiply. Some of the germs, however, are not able to withstand the acid

of the stomach or other germ poisons in various parts of our bodies. They die and can cause no more harm, but others do withstand these poisons and make their way through the body. Many pass into the alimentary canal, which is sometimes called a microbe incubator, and here they are produced in great numbers. It is easy to understand why they are so numerous here. This alimentary canal is about thirty feet long. The food, warmth and moisture in it make it an ideal place for the growth of microbes and hence the great number. We know that they are there and that while they probably do no great harm, they do no good and yet we are helpless when the question comes up as to how to get rid of them. This is one of the many problems left for science to solve.

Formation of Poisons. (Toxins). Effect of These Poisons.

Disease germs enter the body and live on their surroundings, and in return for this, they give off a poison, toxin, as it is called. We know little or nothing about the chemical structure of these toxins but we do know that they are formed inside the cell of the bacteria, are given off freely by the cell, and that they cause destruction wherever they go. They may destroy the tissues surrounding them or they may get into the blood and be carried though the whole body, destroying the tissues of any part of the body. In some cases the nerves absorb them and tetanus or lockjaw results. In some diseases such as diphtheria, the toxin seems to poison different parts of the body. There will be the regulation sore throat of the disease, but there may be also *complications* of liver, changes in the circulatory organs, drop in blood pressure, and other troubles which show that the toxin is working in many parts of the body.

Another danger is that these disease germs multiply greatly, before the body sets up its defense and gets ready to fight them. Then when these bacteria are killed, poison from them is carried through the body.

The only way to avoid this poison, is to keep as free of the disease germs that give them forth as possible and build up a good healthy vigorous body that will be able to combat them if they enter the body.

On can readily see the effect of these poisons on the body. They irritate or destroy the body tissues and unless they are overcome in some way, finally destroy the body.

How the Body Resists Bacteria and Their Poisons.

To a certain extent the healthy body may resist these bacteria and their poisons. The process is an interesting one.

These bacteria are not a part of the human body and come in as sort of intruders. Their object is to reach the tissues of the body to begin their destructive work. Our bodies seem to realize their presence though we know nothing about it. It seems as though the entire body gets ready to fight the disease germs. Let us suppose that a tuberculosis germ enters through the mouth because of close contact with one who has the disease. The germs first go to the stomach. In our stomachs is an acid that kills many bacteria but some of them escape this and go on to the small intestines. The intestinal walls are strong and the germs generally cannot force them but sometimes the walls are not strong enough to resist the disease germs; they give way and the germ poisons get into the tissues. In the tissues, the blood exerts its power in killing the microbe. The white corpuscles of the blood are perhaps the greatest factor in killing bacteria of any of the body resistants. Sometimes the germs are too much for these white corpuscles and they in turn are killed by the germ. Other parts of the body aid in fighting these germs but if none are successful then the disease is free to begin its work, but you can readily see that if all these organs are in good working order, the poor germ doesn't have a very good chance.

When the germ has withstood all these bodily organs, and actually entered the tissues of some part of the body it begins its work and the germs multiply rapidly. It probably feels then that the way is clear for its destructive work but before it gets a very good start, substances seems to come forth created just to meet the need. These germicidal substances, as they are called, assist the white corpsucles. They fight during the disease and afterwards remain in the body a long time, and when they are there, we can not have that same disease again. In case of the measles,

scarlet fever and small pox, we seldom have them again because of this substance which seems to say "you've been in this body once, that's enough".

Antitoxins and Related Substances in the Blood; Tell the Truth in Simple Language.

Our bodies do such wonderful things that we marvel at them. One of the most astonishing is the forming of anti-toxins. As the microbes enter our bodies and give forth their poison, the organ attacked reacts by forming a counter poison. One strange thing about this counter poison is that it has no effect against any other microbe except the one that called it into being. This antitoxin formed by typhoid bacteria will be absolutely useless in fighting against lockjaw germs.

We now have standardised antitoxin for diseases. It is given to people to prevent disease or lessen the seriousness of the disease.

Antitoxin means "against poison". In disease the person may not be able to produce enough, so if some antitoxin is added to his blood, he may be better able to combat the disease.

In explaining the relation of disease germs to the body and showing how the body reacts from these germs, we must take into consideration the age of our pupils. We must be sure that we give absolute facts but the truth should be stated in simple language and made as practical as possible if the pupils are to benefit from it.

White Corpuscles and their Use; Pus.

White corpuscles are called the police force of the blood. They do not unite in groups as most cells but float one by one in the blood. This gives them free sway and they go around seeming to watch for chances to attack the disease germs.

Disease germs would have a free and easy time if it were not for these white corpuscles in the blood. One thing they do is to eat these disease germs. Sometimes the white corpuscles can not

digest them and the germs in turn kill the corpuscles. If this goes on the patient can not live but if the corpuscles can digest the germs, his chances for recovery are good.

Pus is largely white corpuscles that have collected and have destroyed bacteria in the tissues.

The white corpuscles of the body have been likened to a police force. Each corpuscle goes around watching for disease germs. When he finds one he arrests it. He does this by eating the germ. If he is not able to do this, he calls other corpuscles to help him. If you get a splinter in your finger, these white corpuscles rush to the scene and die in making the attack. We say the splinter festered and came out but what really happened was these white corpuscles made an attack when the splinter entered and they were killed in the attack and their bodies formed the pus.

Healthy Resistant Body Best Safeguard.

A healthy resistant body is the best safegurad against disease. The best of us get diseases but we can escape disease more easily if we are well and strong, and if we are so unfortunate as to catch a disease, we are better able to combat it if we have a strong constitution to begin with. We can inherit a weak or a strong body but fortunately we can acquire a strong body if we have the determination to do it. We should learn the rules of right living and adhere to them and should not violate the laws of health. Exposure, exhaustion, lack of good food, bad air in sleeping rooms, and lack of sufficient exercise will weaken our bodies and then the disease germs get in their work.

No matter how strong we are, if too many disease germs get into our bodies, we cannot combat them so we should avoid contact with people who have contageous diseases.

Sometimes we feel the situation is hopeless with these tiny germs all around us, but the best thing to do is to avoid people who are sick, keep up your general health and not worry about germs.

There are about a million and a half deaths in this country each year. Probably half of these are needless. In addition to this there are about three million persons who are constantly sick.

Sickness causes much loss of time as well as discomfort. We should strive to have good strong bodies so we can resist disease.

Catching Diseases; Germs Must Escape from the Patient.

Our ideas about catching diseases have changed considerably in recent years. Science does much toward explaining conditions and yet we understand so little about this body of ours. We think we know how to care for it, yet there is so much to learn.

Certain germs cause certain diseases and these germs must come from the parent germ; they cannot start from nothing.

In the person who has a disease are many disease germs, but so long as these stay in the person, other people are safe but when the germs are given out, the danger comes. If a person were careful he could avoid giving off these germs to a certain extent though he does not have full control of this.

There are various ways in which germs may escape the patient, such as coughing, sneezing, spitting, sores on the skin, and from the wastes of the patient. These will be discussed briefly:

Coughing—In some of our health pamphlets we see a picture of a man coughing and the germs, which unfortunately, we can not see in real life, are pictured flying in all directions. You see a teacher stand before her school and cough. All of the children in her part of the room are exposed to her cold by her carelessness. If little children could be taught that they should cover their mouths when they cough, after they are grown, they would do it unconsciously and in that one way at least, germs would not be carried.

Sneezing—Probably sneezing and coughing should come under the same heading for the results are so similar. The secretions of the mouth, nose and throat, scattered by coughing, sneezing and spitting are very dangerous.

Spitting—Of the coughing, sneezing and spitting, spitting is by far the filthiest habit. While it is unlawful in most communities, nevertheless, it is done a great deal. Especially is this dan-

gerous in tuberculosis. There is danger in spitting on the sidewalk, in the grass, or in a cuspidor containing no disinfectant. It is a bad habit, even among the well and should be discouraged.

Sores on the Skin—So many people are careless when they have small sores or breaking out on the skin. It seems such a little thing to the person, but from that sore may come germs that go to another person and cause serious infection.

From wastes of the patient—In some diseases the germs are in the intestines as well as in the blood and tissues. This is the case in such a disease as typhoid, and in this disease, the microbes are in the bowel movements of the patient. A person gets typhoid by getting into his mouth germs which have come from some one who has had typhoid. These may come by the means of flies or polluted water from wells where these microbes have been washed in.

Good health habits, both by the one who has the disease and those exposed to it, have much to do with keeping the disease from spreading.

Germs Must Be Carried in Some Way.

We have just learned that disease germs must escape from the patient in order to spread and now we come to the question of the carrying of germs from one person to another. As a rule germs do not go distances themselves but are carried to a person in various ways such as, in our water or food, by flies, through the use of the common drinking cup, by contact with persons who have a disease, and by dirty hands and nails. A brief discussion of these different ways will follow:

In water—Impure water contains disease germs. Knowing this, we should see to it that the water we drink is reasonably pure and free from these germs. Our drinking water for the most part, comes from streams or wells. If the stream has been used as a general dumping ground, the water is impure and should go through some kind of a purifying process. If the water comes from a well, we should see to it that the well is not near a cess pool or a barn yard or any place where impurities might seep in. The entrance to the well should be carefully covered.

In Food—Food that is not fresh will probably contain disease germs. Care should be taken that our fruit and vegetables are not beginning to decay, that our meats have been inspected, that our milk is pure and sweet and that our other food has come from a sanitary grocery store where it has been carefully handled and kept clean.

Flies—Flies are called the "universal enemy of man". A few years ago flies were taken for granted. We thought we had to have them; that they were a part of the coming of summer. Now we campaign against them for as we study flies and realize the great danger in having them around, we feel we must do all we can to eradicate them. Flies spread disease by carrying germs. They hover over any filthy place where germs are countless and then fly into our houses, walk over our food and into our milk and leave germs. Flies have been examined and found to have millions of germs on them. Their feet and legs are covered with tiny hairs to which the germs adhere. Unfortunately we cannot see these germs. If we could, we would fear a fly laden with germs as we might a poisonous snake.

Flies carry germs of nearly all diseases and everything should be done to destroy them.

If people could be made to realize the danger in one small fly, they would kill it at once and thus help to lessen the number.

Drinking cups—It seems only a few years ago that we had the common drinking cup. We could go into a rural school where there were thirty children present. If it were in the winter probably half of them would have colds. All would drink from that one tin dipper in the pail of water on one of the benches. Now we have the paper drinking cups and the drinking fountains. Anyone who has disease germs, and most of us have more or less, drinking from a cup may very easily leave germs in the cup that the next person may take in. Even healthy people give off disease germs and they may enter the body of one less healthy and cause any amount of trouble.

The common drinking cup is a great spreader of disease and should be abolished entirely.

By Contact—Not all diseases are contageous but many of them are more or less so and if we come in contact with people

who are sick, we may take the disease. In the case of our most contageous diseases, the patient is quarantined and people are kept away from him. That eliminates much danger but in less contagious diseases, the danger is really greater. We are more careless in these less contagious diseases and the patient is more careless so that we come in contact with him, get his germs, and are in great danger of getting his disease.

There is danger in contact with the patient or by coming in contact with the things he has used.

Dirty hands and nails—It is necessary that we keep our hands and nails clean. We should have enough pride to keep them clean for the sake of appearance but a more important reason is to avoid the spread of disease germs. Some one has gone so far as to make the statement that dirty hands probably cause more disease than any other agent. That may seem a little strong but there is doubtless considerable truth to it. Our first thought is that we should teach children to keep their hands clean. So we should; but children are not the only ones who have dirty hands.

Just watch farmers and see how many of them wash their hands thoroughly before milking.They should, and some do. The housewife should always wash her hands when she goes into the kitchen to prepare a meal. You will probably find the average housewife more particular about this than the average farmer; but how essential for both to have clean hands!

Children should be taught to always wash their hands before eating. They probably will insist that their hands look clean and perhaps they do but the last thing a child should do before eating is to give his hands a thorough washing. Children should also be taught to wash their hands when they have been places where there are crowds of people, as on the street car, or in crowded stores. The children touch things that others touch and have a very good chance of collecting dangerous germs.

You meet many people on the street with nails that indicate absolutely no attention. After a study of germs you surely can realize the great number of germs that could lie in that small space under the nails.

Germs Must Gain Entrance to the Body Tissues of the Second Individual; Prevention.

Disease germs in themselves are dangerous and many times they break down our vital resistance and pave the way for more serious diseases. There is no danger, however, unless disease germs are carried from those who are sick to those who are well. Germs must gain entrance to the body tissues of the second individual. This may be done in several ways: Through the mouth and nose, the digestive tract and through open cuts and the like.

Through the mouth and nose—We take in many disease germs through the mouth and nose. The air we breathe is never pure and the food we eat and the water we drink are never absolutely free from impurities. We may go up to a desk, pick up a pencil and unconsciously put it to our mouth. We do not know who has handled that pencil before us and what kind of germs are on it. If some one who has a cold coughs near us, we can so easily breathe germs from his cold. It is easy in many ways to take in disease germs through the mouth and nose.

Through the digestive tract—Impure milk and impure water contain disease germs. Different diseases can be carried to the digestive tract through these agents. Suppose a family has typhoid fever and the empty milk bottles from their home have not been thoroughly sterilized. Milk from these bottles can easily carry typhoid to anyone who drinks it.

Food that is beginning to decay contains bacteria and can be easily carried to the digestive tract. Any food we eat that is not pure is dangerous and should be avoided.

Through open cuts or sores—As soon as there is a break in the skin, there is danger of infection. Germs are all around us. They live in our skin, on our clothing and in water. If there is an open cut or sore, unless it is cared for at once, these germs can get into it and infection may set in and trouble may follow.

Prevention is so much easier and better than cure. If people could only be taught good health habits and learn to avoid other

people who have diseases, be careful of the food and water used, become enemies of flies and keep their hands and nails clean, they would go a long ways towards preventing disease.

Precaution in the Sick Room.

Great precaution should be taken in the sick room to prevent the spread of disease.

The dishes used should be kept for the person who has the disease and not be used by others. These dishes should be washed in boiling water.

If the disease is one of the more serious of the contageous diseases, the clothing the patient uses during illness should be burned or at least carefully fumigated. The bedding should be washed thoroughly and some disinfectant used in the water. The bedding should be allowed to hang in the sunlight for some time to make sure it is perfectly free from germs.

The wastes of the body should be carefully destroyed. This is especially necessary in typhoid fever but is a safe precaution in any disease.

The patient should be carefully isolated during illness. To what extent he should be kept entirely away from people depends on the nature of his disease but it is usually better for both patient and others if there is little going to and from the sick room.

The nurse should be careful of her clothing as she could so easily carry disease from her patient to those outside the room. However, nurses' uniforms are of such material and style that they do not easily carry disease germs.

How Germs Are Scattered—Human Carriers—A Perfectly Healthy Individual May Harbor and Scatter Disease Germs—This Fact Extremely Important.

Disease germs may be carried in water and in food but human carriers of disease are more to be feared than any other. They are more difficult to avoid. We can be reasonably sure that the water we drink is not contaminated though water abso-

lutely free of germs might be difficult to find. We can see to it that the food we eat is clean and fresh and well prepared but if we mingle with people at all we can hardly avoid human carriers of disease. We may walk along the street and meet a person with a cold who takes occasion to cough or sneeze just as he reaches us. While out of doors is the safest place, we may get these disease germs he has given forth even then and in spite of ourselves. If we go into a store, we meet people who are not well and are giving out disease germs into the air and on the food we buy. If we go into a meeting where the room is crowded, there may be one person, though doubtless there are more, who give off disease germs that may contaminate the whole room. The most dangerous thing we could do would be to go into a room where some one is ill with a contageous disease. Anything we touch might be covered with these germs. You can readily see that these human carriers of disease are all around us, scattering disease in every direction, and try as hard as we may, we can hardly hope to escape all of them,

As we study about the many ways diseases may be scattered, we almost feel that we are not safe anywhere. As a rule we do feel safe with a healthy person, while we are safer with him than with one who is sick, even the healthy one may harbor and scatter disease germs.

Suppose a healthy man has been drinking water contaminated with typhoid germs. He takes these germs into his body, but because he has a healthy resistant body, he can battle with them and does not get typhoid. The acid in his stomach kills some and others are killed by the white corpuscles in the blood, but some live and are given off and these may enter the body of some one who cannot resist them and cause him to have typhoid. So we see even the healthiest people may give disease germs to other people.

We need to realize the danger of disease that are all around us. When we know that even a healthy person may scatter disease germs, we should build up good, strong, healthy bodies to resist all diseases.

Importance of Direct Contact in Epidemics.

When there are epidemics, the safest way to protect the public is by quarantine. Houses are placarded in two ways. If the disease is of a serious nature, such as scarlet fever or diphtheria, the placard means that people are not to go back and forth from the house. If the disease is of a less serious nature, such as whooping cough or mumps, the placard is simply a warning to people and they may use their own judgment about going in.

While disease germs may be carried by a third person, direct contact with the person who has the disease is most to be feared. The person who is sick may give off germs or germs may be on any object in the room that the patient has touched. When we know that a person has a contageous disease, we are wise if we keep entirely away and have no direct contact with him.

Relate This Fact to the Crowds in Picture Shows, Churches, and Schools Where Catching Diseases are Prevalent.

Sometimes when there is an epidemic of some contageous disease, it is of such a serious nature that schools and churches and other public places are closed. This is done, however, only in extreme cases. As a rule people are left free to attend picture shows, churches and schools and these are the very places where disase is spread.

Supose a person is coming down with diphtheria and goes to a picture show. As a rule the room is crowded and the air bad. Think of the people sitting around this one who is taking the disease. Germs are given forth into the poorly ventilated room and the chances are that a number will come down with diphtheria.

Suppose a child goes to school in the morning and by noon the teacher discovers that he is coming down with measles. In his school work he has probably moved around in the different parts of the room, and has played with children at recess. There is hardly a child in school who has not been exposed to the measles. The condition is the same at any public place. In case of an epidemic, the less we go to these places, the less likely we are to get the disease.

Emphasize Habits of Cleanliness, Thoughtfulness, Self-Control, Helpfulness to Others, and Honesty.

Habits of Cleanliness—There is more truth than fiction in the old saying that cleanliness is next to godliness. In this study of germs, there is probably no greater factor in the destruction of or freedom from germs than cleanliness. There are so many little ways in which we can be careful about our food. It should be kept covered and in a sanitary place and handled only with clean hands.

Cleanliness of our bodies is a wonderful germ preventative and clean hands are so important at all times. At best our hands touch things that are covered with microbes and when they are not clean, conditions are much worse. They should be washed frequently and kept away from the face.

Thoughtfulness—The healthy individual should be thoughtful in preventing disease. He should be careful of his bodily habits, aid in protecting others from disease and keep away from places infested with disease germs.

It is even more necessary for sick persons to be thoughtful. When they go among others, they spread disease. People with diseases such as tuberculosis should be thoughtful and avoid coughing or spitting in public places.

Self Control—Self control is a valuable asset in times of illness, and especially so in epidemics. It is valuable to those who are ill, for, fear on the part of a patient, often lessens his chances of recovery; it is valuable to those who are not ill for, if people are sensible about things and use self control in times of danger, it lessens the danger.

Helpfulness to others—The paragraph on thoughtfulness would fit in nicely here in that thoughtfulness is being helpful to others. So many people around us seem to have so little idea about taking care of themselves. They expose themselves to bad weather, poor food, and sick people. If we could only make them realize the great dangers, we would be helping them much.

Honesty—Honesty may be a rather peculiar topic to speak of in connection with disease germs, but it has a direct bearing on the subject. There are people around us who have diseases—know

they have them—but are not honest enough to admit it. In the opposite extreme we have the people who are ill, or at least think they are, who make their illness the main topic of conversation. As we sometimes say, they enjoy bad health. We do not commend these people for their honesty, if we may call it such but we do commend those who have diseases that are carried by germs who let us know about it so we may not be exposed to them.

Compoition Subjects.

Each of these composition subjects will be discussed briefly and the students may enlarge on them.

Clean Hands and Health.—This is an important subject. In these days of running water and good soaps, washing our hands should be a pleasure. Whether it is to the average school child, may be determined by an examination of his hands. We don't expect a child to keep his hands clean all the time when he is playing or working at school, but we do expect him to start with them clean in the morning and have them clean at meal time. Any grade teacher can tell to what extent this is done. The sooner we can make a child feel pride in clean hands and nice looking nails, the sooner we have accomplished something worth while in fighting disease germs. Especially with small children, is it difficult to explain much about disease germs, but we should begin as soon as we can and make children realize what clean hands mean.

It is said that millions of germs are in the dirt under the finger nails. Think of the danger when those fingers are put into the mouth. In this connection comes a very bad habit some people have of biting the finger nails. This is a bad habit first of all because of the appearance of it and then it ruins the finger nails and last of all because when we do it, we are just eating germs.

Clean hands and health are closely allied and one depends much upon the other. The teacher herself should set a good example and have clean hands and well kept nails.

Protection of Food from House Flies.—There are some things we take for granted. In times past the fly was one of those plagues that was taken for granted. A few years ago germs were not known, but since we have learned about them, we find that

the house fly is a great carrier of germs, and knowing this, we have set about to destroy the fly. As one of our health bulletin says: "Remember, no filth, no flies." This is true in that flies like filthy places, and carry their germs from those places to our homes.

Cooking and Disease Germs.—For the most part we cook our foods but many fruits and some vegetables are eaten raw. These raw foods are good for us but are more dangerous than cooked foods for they contain more bacteria. However, if they are carefully washed, they are comparatively safe.

Cooking foods kills the bacteria and makes them safer for us to eat. Meats especially should be cooked as they often contain parasites that are harmful to us.

Human Carriers of Disease.—This subject has been discussed in the first part of this topic "How Germs are Scattered."

Typical Diseases.

As suggested in the course of study, the following diseases will be discussed: Tuberculosis, Typhoid, Diphtheria, Smallpox, Colds, and Infections of Open Sores and Cuts.

The important points to be covered in the treatment of these diseases are:

The nature of the disease
The effect upon the body
The way in which the germs enter the body
Their location in the body
How they leave the patient
How they are carried
Precautions to be observed about the sick room.

In some cases the prevention and curative treatments for the disease.

Tuberculosis.

Tuberculosis sometimes called the Great White Plague, is a much dreaded disease and until recent years a rather hopeless one

IN REGARD TO THESE PHYSIOLOGIES

I am truly very, very sorry to have kept you waiting so long for these books but the Course of Study was not ready until August 1, and after that date, I had sixteen different books to write. Much of the material was very hard to find and it took me several weeks to condense and arrange it. Then when it went to the printers, I was delayed again.

I am sure it will never happen in the future with any order you may send me and I hope the books will be of much value to you.

MAMIE C. TEX,

Taylorville, Ill.

as more deaths resulted from it than from any other disease. We used to think that if a mother had this disease, there was no chance for her recovery and more than that, in all probability some of her children would inherit it from her. It is just in recent years that this idea has changed. We now know tuberculosis to be a germ disease and not one that can be inherited. We probably got this wrong idea from the fact that when a mother has this disease, there is the chance that her child might get it because he inherits the tendency to give in physically to tuberculosis germs.

This discovery of the germ cause of tuberculosis has done much towards making it less dreaded but it is still a disease, the name of which, causes one to shudder. There is much more chance of recovery, however, than ever before.

Except under very special conditions, the tuberculosis germ grows only in the animal body, which greatly lessens the danger of the spread of the disease. However the germ will live for months or even years outside the body and then be ready to grow when it enters the animal body. It lives best in damp dirty places or in decaying material.

One can often tell by a persons looks, the nature of his disease and this is especially true of tuberculosis. The person has a thin shriveled appearance and usually a hacking cough. There is a loss of appetite, the patient begins to get thin and weak and there is a slight fever and often times spitting of blood.

While these germs may grow in any part of the body, the more favored place seems to be the lungs. Tuberculosis of the lungs is called consumption. The germs seem to have a way of growing in the tssues of the body and spread destruction as they go.

Sometimes the disease comes from the milk of diseased cattle, though that is one thing that is being watched carefully these days. More frequently the disease comes from the sputum of a consumptive. When the patient coughs or sneezes, many germs come forth and these germs, if they are allowed to become dry, will live for some time. If a patient is careful there is almost no danger to those around him. Every precaution should be taken

that the germs that are given forth shall not dry and with this care there will be little chance for a spread of the disease. Paper napkins are best to use and they should be burned at once.

If one fears this disease, his best chance is to build up his general health so he has strength to combat the disease. Good food, fresh air and cleanliness are essential to good health. It is a rare thing for one to get the disease out of doors. If one has the disease, rest, good food and lots of fresh air are the essentials and are the important factors rather than medicine.

There are sanitariums where one may go to get the proper care or one may live at home if every precaution is taken not to spread the disease. Sunlight kills the germs more than anything else and the patient should endeavor to live out of doors.

Surroundings have a great influence on tuberculosis patients or on those who have a tendency to give in to these germs. Our large buildings should be well ventilated and our houses should be light, open and cheerful. Damp cellars should be avoided. In the home, care should be taken to avoid stirring up the dust in cleaning. The vacuum cleaner is valuable in that it takes up the dirt rather than stirs it up to settle in some other part of the room.

Tuberculosis is a disease in which one can cure himself. If he lives out of doors where he can get an abundance of fresh air and sunlight and has the proper food, he may cure himself without the use of medicine. While tuberculosis is a contageous disease patients are not quarantined but they should have the interests of others sufficiently at heart, that they would be careful not to spread the disease. The greatest of care should be taken that nothing that the patient uses is used by others and that all discharges from the nose and mouth are destroyed.

Typhoid Fever.

Typhoid fever is another dreaded disease and doubtless comes next to tuberculosis in seriousness. It has been found that probably one out of every ten cases is fatal and those who do get over it are left with some weakness as a result of it.

The bacteria that cause typhoid are taken in our food or water. These bacteria increase greatly in the small intestines

and form a poison that goes through the whole body. Unless something is done to reduce the number of bacteria which grow so rapidly, the body is injured and death results.

The body sets up resistance to these germs as soon as they begin work and sometimes proves stronger than the germs, but this can not always be done. In recent years a specially prepared vaccine is injected into the veins. Almost immediately the white corpuscles multiply, even become six to eight times as numerous as before and the long run of fever that used to be a part of typhoid is avoided.

Typhoid germs are carried by the wastes of the body. Any carelessness in the disposal of these wastes will doubtless mean sickness to others. There is danger if wastes from the intestines and kidneys are thrown out that they may seep into the ground and contaminate the drinking water or from the soil may get on the garden vegetables or that if they are left on the ground flies will find them and carry those disease germs to our food and give us the disease.

There is little danger of contagion in typhoid if precautions are taken in the sick room and wastes of the patient carefully destroyed.

Diphtheria.

Diphtheria is a contageous disease and a very serious one. sometimes grown people have it but it is much more frequent among children.

The disease attacks mucous surfaces and covers them with a membrane which is tough and leathery. While the disease affects the throat especially, yet it weakens the whole body. Often times the child goes to bed complaining of a little cold or hoarseness and before morning the disease will have fully developed. There seems to be times of quiet and then spasms when the child seems hardly able to get his breath. Often the growth of membrane in the windpipe seems to almost stop the breathing.

Diphtheria many times is fatal and even if the child is able to resist, there are often results such as paralysis of some part of the body, or the throat or other parts of the body are left in a weakened condition.

The disease is carried by the spreading of the germs the person gives off. Forunately these germs do not go great distances so the danger is in handling anything that has in any way come in contact with the patient.

If there is any chance that a child has diphtheria, a physician should be summoned at once. All we can do is to try to keep up the strength of the patient until help comes.

When the diphtheria germs enter our bodies, they give off toxins or poisons. Fortunately we have with us strength to battle with these disease germs and science is helping us in this work. The first thing is to quarantine the patient so others may not take the disease and then the antitoxin should be employed at the very beginning of the disease.

Diphtheria is reduced some what by sanitary living. This with quarantine and antitoxin, gives us a much better chance for battling with the disease.

Small Pox.

Another of our contageous diseases caused by germs, is small pox. The disease used to be looked upon with horror for it is very contageous. It often left the person disfigured for life. There have been rather serious epidemics recently but no comparison with the epidemic in times past.

The discovery of vaccination has done much to get this disease under control. The danger now comes from the disinclination of people to be vaccinated. Fortunately in many schools today it is required so that the children are safe from the disease.

The germs of small pox are hard to destroy; they live a long time. Infected clothing may carry the small pox germ but it is usually transferred from one person to another through the air.

A strict quarantine is necessary in small pox and every thing about the patient should be disinfected.

Colds.

Probably more of us suffer from colds than from any other one disease. The word "cold" is hardly the proper name for the

disease as cold air does not produce it, but we all know it by that name and will probably go on using the term.

It seems almost useless to explain the nature of the disease, for when we begin to sneeze and cough and have pains all over our bodies, we usually know our trouble.

Colds are serious because they are contageous, they maks us less able to do our work and they fequently are the beginning of other diseases such as tuberculosis, pneumonia and diphtheria.

In some diseases a germicidal substance is formed by our bodies to resist the disease. In the case of measles, scarlet fever etc., some of the bacteria remains in the body so we will not take the disease again, but this germicidal substance formed in colds remains such a short time that in a few hours after a cold leaves us, we may take another one.

Sometimes medicine is taken for a cold with good results but there are other ways of avoiding them or curing them when they come. Vigorous exercise taken out of doors will often stop a cold if it is just beginning and deep breathing is always helpful.

Those who protect themselves too much by heavy clothing catch cold more easily than those who do not dress so heavily and who get used to exposure. If we have colds we should avoid drafts, eat light food, and often times a few days spent in bed would be a wonderful help.

We frequently hear some one say he is not ill—just has a cold but colds are serious and should be taken care of.

Infection of Open Sores and Cuts.

Open sores and cuts would hardly come under any disease but they are important in the study of disease germs. Even in a slight scratch there is a danger of infection. In deep cuts or sores there is greater danger of infection for there is the possibility that some foreign substance may be in the cut. In this case blood poisoning may result. If the wound is infected it soon gets red, swells and begins to hurt, and if blood poisoning sets in, the person may be seriously ill.

The reason for infection is that germs get into the wound. Germs may come from anything that touches it so there is need for care that absolutely nothing touches the wound. The white corpuscles can fight off some of these germs but if there are too many, infection results.

Sometimes a cut bleeds and if there is not too much loss of blood, this is a good thing, for the blood washes impurities from the sore.

A cut or sore should be carefully bandaged after it has been washed, and care taken to keep it perfectly clean that there may be no danger of infection.

THIRD QUARTER.

SANITATION.

Sanitation vs. Hygiene.

Sanitation has to do with the public health and hygiene with individual health. While these two terms have different meanings, they are closely allied. Individual health influences public health and public health on the other hand influences individual health.

We live in wonderfully constructed houses which we call our bodies. The study of hygiene should show us that we need to take care of these bodies and keep them in good repair just as we do our houses of brick and stone and mortar. We can do this if we keep disease away from our bodies so that they may be kept strong.

We ought to strive to have good health as our usefulness in the world depends upon the mental and physical energy we have.

Sanitation is the study of conditions that have to do with the health of the community. Sanitation treats of the maintenance of health as well as the prevention of disease. If there are no laws governing health, the chances of our own individual health are not very good. Thus we see that sanitation and hygiene depend upon each other, and that each is an important factor in bringing about the good health of a community.

Why Public Health Measures are Necessary.

Public health measures are necessary for the protection of the people. If we lived in an ideal land where every one was careful, unselfish, and thoughtful for others, public health measures would not be necessary, but often people with diseases do not protect others from it so it is necessary that we have a board of health for this purpose.

The United States has taken this matter in hand and has extended its authority three miles out into the sea in every direction. Before this was done, ships could come from other countries and bring all kinds of contagious diseases, among which were the dreaded smallpox and yellow fever. We knew that epidemics of these diseases were in the countries but it would ruin our trade if we let that fact keep ships from those countries from entering our ports. As a solution to the problem, health officers were appointed to inspect these ships. We can not go into detail as to how this is done but all are familiar with Ellis Island, in New York Harbor, where people with diseases are kept and either cured or sent back to their own countries.

A disease of Oriental countries which is much to be feared is the bubonic plague. Rats spread this disease. A rat is not particular about his food. He will eat almost anything and on the ships eats up the bad food that contains germs. The public health department is doing everything to exterminate rats such as hunting them out from ware houses and piers, and stringing steel plates on cables so that the rats can not run along the cables to shore when the ships enter our ports.

Science has done much to overcome plagues or epidemics which years ago killed many. Diseases are not destroyed but only checked. Carelessness causes them to flourish. Here is where our board of health is necessary—to prevent this carelessness. Vaccination has done much to stop smallpox and hygienic measures have greatly reduced the death rate of scarlet fever, typhoid fever and measles.

The United States Census Bureau reports that by the introduction of pure water supplies, the annual death rate from typhoid fever in cities, has been greatly reduced. Public health measures are steadily increasing the average length of life.

How the Increase in Population Has Complicated the Health Problem.

From the time when our forefathers landed in this country, the people have had health problems to solve. As time goes on science does much to solve these problems but the great increase in population makes them more and more complicated.

When people live some distance from each other they have rights and privileges which they do not have when they live close together.

Man should have pure air, good nourishing food, a good home, a clean body and attractive surroundings. In the country this is not a difficult problem but in the city the increase in population makes it a serious problem.

Our cities, however are every where organizing to provide the essentials of sanitation. There are street cleaners who keep the streets as clean as possible. Parks are provided where the people can get fresh air. Food inspectors are appointed to see that only pure food is sold under sanitary conditions.

To keep food and air and water free of disease germs can not help being a problem where people live so close together but with a good health department to watch the needs of the people, disease is kept down.

Why it is Necessary for All of the People to Observe Public Health Measures.

Public health measures are not of very great value unless *all* of the people observe them. We may do our part but if our neighbor does not do his we are in danger.

Let us suppose, to illustrate this point, that ten families in our small town have measles. All of them are quarantined. A boy in one family is not very sick with them so he goes to the movies in the evening. He will do more harm in one evening than the other nine families respecting the board of health rulings will do in their whole period of quarantine..

Suppose again that a member of the family living next door to you has typhoid fever. We know that typhoid germs are carried by the wastes of the body. If this family is careless and throws the wastes in the back yard near the well where you get your drinking water, the water may become polluted and the disease carried to your whole family.

Illustrations could be drawn from any of the contageous diseases. The danger comes not from the nine families who obey

the regulations of the board of health but from the one careless, selfish family who considers only its own wishes.

These illustrations show that public health measures are necessary and that it is essential that *all* the people observe them.

Carelessness of a Few May Endanger All of the People.

We are to discuss the reason why carelessness and neglect on the part of a few may endanger all of the people through the water supply, food supply, by careless disposal of sewage, by breaking quarantine regulations, by refusing to obey muzzling ordinances, through disposal of animal refuse which breeds house flies and the like.

Many people are careless, some selfish, and other not well informed. Unfortunately we must live in communities where there are all of these classes of people.

We will discuss briefly the ways in which carelessness and neglect on the part of a few endanger all the people.

Through water supply.—Water is so important to the health of people that there should be a good supply of pure water. Suppose a town gets its supply of water from a near by lake. A careless man wishing to dispose of some rubbish could throw a load of it into this lake and as a result the water would be unfit for use.

Through food supply.—A merchant may be careless about the care of his groceries. When he displays cookies, candy, unwrapped bread or anything that cannot be washed before it is used, he is selling disease germs with the goods. When the butcher sells meats that have not been inspected and that are not strictly fresh, he is endangering lives by so doing.

By careless disposal of sewage.—A housewife may have the habit of throwing her garbage in a vacant lot behind her house. The flies will find this a regular banquet table and from this decaying matter, carry germs in every direction.

By breaking quarantine regulations.—The board of health quarantines to isolate the patient and keep him from spreading disease to others. If he breaks quarantine, he is breaking the laws and injurying others.

By refusing to obey muzzling ordinances.—In cities and larger towns dogs must be kept muzzled as a protection to people passing on the street. Naturally each one feels that his own dog is harmless but it is always the unmuzzled dog that bites.

Through disposal of animal refuse which breeds house flies.—Animal refuse is one of the best places for breeding flies. If the animal refuse is not cared for but is allowed to accumulate in the barn yard, from it will come numerous house flies and these flies carrying dangerous germs may enter your house and carry these disease germs to your food.

When we can teach people to be careful of these seemingly little things and show them that the few who are careless endanger all of the people, we may hope for improved conditions in the health of our people.

These Points Suggest Excellent Subjects for Compositions.

The points in the topics just discussed would make excellent subjects for compositions. If the pupils study into these health problems they will become so interested that they will be careful themselves and try to help other to be careful.

Value of Personal Qualities.

The course of study urges that we bring out strongly the value of personal qualities such as reliability, self control, honesty, thoughtfulness for the welfare of others, and helpfulness to others in times of epidemics.

If people were willing to do the right thing in times of an epidemic, the danger of spreading the disease would be much less.

To illustrate the value of these personal qualities in epidemics, let us suppose two families A and B, have the diphtheria and have been quarantined by the board of health. The first family A, has respect for its quarantine. It realizes the danger of spreading the disease and does not try to deceive the public about it. It is careful that nothing goes from the house that would in any way cause others to have the disease. It sees to it that when things

are brought to the house, the person who leaves them is not exposed in any way. It does not leave the house until the patient is well of the disease and all evidences of the disease are destroyd and everything properly fumigated.

In the next house is a family B, who pretend that the disease doesn't amount to anything. It, though quarantined, sneaks out whenever possible and scatters germs broadcast. This B family goes among people before it should and is careless about fumigating.

This family B is one of the great hinderances to the welfare of any community and should be made to feel by the people of the community that it is a menace and an undesirable part of its life.

Cases for Discussion.

The course of study suggests that the pupils *observe* and list cases for discussion in class where the public health is, or has been, endangered by one or a few who fail to observe regulations relative to quarantine and the like.

Work of this kind would doubtless prove interesting to the pupils. It would be something out of the ordinary and might prove to be a very helpful proceeding. In every community there are cases that would make helpful material for investigation and study. There are families where typhoid fever occurs regularly. There is usually a reason for this which upon investigation, the pupils might surmise. This would prove interesting and instructive to the pupils and might, if worked out with officials aid, prove helpful to the family itself.

There may be cases where contagious diseases such as measles or whooping cough are found in families and those families are either not quarantined or are ignoring the quarantine sign. The more our pupils investigate these cases, the more interested they will become and the more careful they will be when they are quarantined for disease.

Education is one of the greatest factors in this whole question. Professor Pasteur, to whom we gave much credit in the study of bacteria, says that it is within the power of man to rid himself of

every bacterial disease. If this is true we can do a great deal by teaching our pupils to observe conditions and do all they can to better these conditions and learn to take care of their own bodies.

Everyone Should Be Compelled to Obey Health Regulations.

There are various reasons why the public, represented by the board of health, has a right to compel every one to obey health regulations.

Laws have to be made to make people do right and a police force must be organized to make them obey the laws. Unfortunately people will not do right for rights sake but must be forced to do it. The public, which is represented by the board of health, has a right to compel every one to obey health regulations the same as they obey other laws.

The board of health has done much to protect people from disease. It makes regulations for the purifying of our water supply and the careful handling of our food. It makes regulations for the disposal of sewage, perhaps the greater factor in lessening the spread of disease germs. When people are sick with contageous diseases the board of health can quarantine them, insisting that they stay at home until the disease is over and the house is fumigated and made safe for others.

The board of health does a valuable work and people should be compelled to obey its health regulations.

WATER SUPPLY.

Review.

A special review of the work done in the earlier grades, relative to clean water, will not be given as the discussion of water supply that follows covers practically all of the work of the earlier grades.

Local Conditions.

It is very valuable, with the pupils of this grade, to make a careful study of the locality of the water supply. The pupils

should know where their drinking water comes from and the sanitary conditions of the surroundings of the water supply.

Maps showing the slope of the land, and the possible sources of pollution are helpful. The pupils could draw the maps representing the location and surroundings of the water supply to show whether there is any liklihood of water pollution.

If there are water works or water purifying stations near, these may be studied to advantage.

All of the above work depends wholly upon the locality and must be worked out by each individual school.

The Purification of Water.

Water is one of the essentials of life and is even more necessary than food. Water is used in great quantities and for many purposes. It is used for drinking purposes, for cooking, for cleaning of all kinds, for fire protection and in manufacturing plants. For drinking purposes and for cooking, it is necessary that the water be pure or at least free from disease germs. There are three ways of purifying water, by filters, by chemicals and by boiling. These three ways will be discussed separately.

By filters.—Cities usually have to get their water from rivers or lakes. Often times sewage has been emptied into these sources and the water is polluted and not safe to drink but must be purified in some way. One of the best ways is to run the water into a large reservoir where it is allowed to stand until most of the dirt settles to the bottom, and then it is put through a filter. Sand is usually used as a filter for sand seems to take out the dirt and the germs better than anything else. Often there are several of these filteration beds. The first will be of coarse gravel and each bed will be finer so when the water comes through the fine sand it is clear and reasonably pure. Filteration removes the solid particles to which bacteria cling. Then the soil bacteria helps in this filtering process by seizing these disease germs and in some way changing them into harmless substances.

By Chemicals.—Sometimes alum is put into water before it enters the sand filters. Alum assists or rather quickens the process of purifying. Chloride of lime is used to destroy bacteria

directly. It purifies the water but if too much is used it gives to it a taste that is not pleasant. Chemicals are sometimes used to soften water used for washing but purifying water by chemicals is not as satisfactory as by filteration.

By boiling.—Boiling is a method of purifying water that any one can use. The water should be boiled about twenty minutes, then put into clean bottles and covered. In rural districts this is about the only way of purifying water. Boiling gives a rather flat taste to the water but makes it pure and safe to drink, and is a very useful method in times of epidemics caused by impure water.

Danger of Surface Drainage Into Dug Wells and Pollution of Streams From Sewage.

For the most part our water supply comes from wells or streams of water. Some cities are so fortunately located that they can get their water supply from mountain streams but cities so situated are few compared to those which must depend upon wells and streams for their water.

The danger of surface drainage into dug wells can be readily seen. Deep wells get their supply from veins of water running far below the surface of the earth. While these may not always be pure, as a rule they go through a filtering process provided by nature and if the entrance to the well is protected so dirt and refuse can not get into it, the water from the deep well is reasonably pure. Dug wells are not very deep and must depend for their supply either upon water from the surface or water that has seeped into the earth not far from the surface. We can plainly see the likelihood of impurities being washed into the well from the surroundings. Even if the entrance to the well is walled in, as it should be, the water that seeps into the ground does not go through enought of a filtering process and impurities are easily taken into the well.

Where the supply of water is taken from a river, the water is bound to be impure. Protect the river as authorities may, there is always some one who will be careless about throwing refuse and sewage into the stream. To be safe for drinking purposes, water must be purified if it comes from a body of water.

Heavy Rains Affect Wells Fed Upon Surface Drainage; How Water May Reach a Well Although the Level of the Soil Slopes Away From the Curb.

The falling of heavy rains has a great effect upon wells that are fed to some degree by surface drainage. This is almost too self evident to need discussion. A heavy rain washes away whatever is loose on the ground and often carries it some distance. If a well is fed by surface drainage, when a heavy rain comes, pollution of all kinds is washed into it and the water is made unfit for use.

Wells are not fed entirely by surface water in shallow wells so even if the mouth of the well seems to be higher than the soil around it, the impurities go into the ground and are washed into the veins which feed the well and make the water impure.

Water must go down some distance into the ground before a natural filtering process takes place. Often water, seeping into dug wells from the surface does not pass through sufficient earth and sand to purify it.

Contamination of Water by Common Drinking Cups, UnCleanliness and Human Carriers.

Absolutely pure water is not found very frequently but we do make it free from disease germs and safe for people to use. Water may come from a faucet in a high degree of purity and be polluted after it is drawn from the faucet. This may be done by the common drinking cups, by uncleanliness, and by human carriers.

The common drinking cup has been supplanted in most places by drinking fountains and the individual drinking cup. Not so many years ago, we had one pail of water and one drinking cup for an entire room of children, in school. We have heard so much about the dangers of the common drinking cup, that we do not consider using it any more. When all used the same cup, one diseased child could expose a whole room full of children when he drank from the cup.

Pure water may be made dangerous by uncleanliness. If the water is put into dishes that are not clean or left in unsanitary surroundings, it soon becomes polluted.

Human carriers of disease can contaminate good drinking water by using cups and leaving them for others to use. So many people, who are not well and whose bodies give off disease germs constantly, are not careful when around other people and so cause sickness among others.

Ice Supply; Survey of the Ice Pond; Artificial Ice and Its Character Relative to Purity.

Ice made from impure water is just as dangerous as the water itself. Freezing does not kill disease germs. Freezing simply makes the germs inactive and when they get back to a favorable location and temperature, they come to life.

If ice is to used in the drinking water, we should be sure it is made from pure water or dangerous results may follow.

If ice is taken from a pond near by, have the pupils make a survey of the immediate locality for sources of pollution. This is practical work for the pupils depending wholly upon local conditions.

Artificial ice is ice frozen by an artificial process rather than ice taken from a pond. Inasmuch as the freezing process does not kill bacteria, artificial ice is as pure as the water from which it is frozen.

Compositions.

Composition subjects are suggested. These will each be discussed briefly and the pupils should be able to write longer compositions from them.

Need of cleanliness about our water supply.—There is need of cleanliness about our water supply whether it comes from a well or from some stream. The top of the well should be cemented and carefully covered that no impure water can get into it and that no refuse can fall in to pollute the water. Water

coming from a stream should be filtered and care should be used that every thing about the filtering and carrying the supply to the house should be kept in perfect condition. So much water is used by every one that it is necessary that it be kept clean.

The location of the well.—When planning for a well, care should be taken in choosing a location. We must be sure that water from cess pools or barn yards can not find its way into the well. If we want good pure well water, we must be careful of the location of its source.

Disposal of sewage and our water supply.—Disposal of sewage is a problem in itself because so much harm can come from sewage if it is not properly disposed of. Care must be taken in the disposal of sewage that is is not thrown into a stream that furnishes water for people and that it will not drain off into some well that is used for drinking water. Sewage and water must be kept far apart.

Our water supply and typhoid fever.—The germs of typhoid fever are some times carried in our drinking water. As the germs come from the wastes of the body, these wastes should never be thrown where they can be washed into water used for drinking. Carelessness in disposal of these wastes have resulted in hundreds of cases of typhoid fever.

MILK SUPPLY.

A review of the contamination of milk through different sources will not be given as these points are included in the discussion which follows.

The Danger of Human Carriers who Sometimes Handle Milk.

Milk may be taken from healthy cows and be pure and sweet but be contaminated, before it reaches us, by those who handle it. Picture two milkers: One farmer comes in from his work in the field. It has been a hot afternoon. He is in a hurry to do the milking before supper as the family is going to the movies in the evening. His clothes are covered with dust from the grain he has been hauling. He has put his team in the barn and his hands have on them the dirt that has come from the field and from the

care of the horses. He lights his pipe, snatches a pail that has been standing on a bench near the house since morning, does not take any time to clean the cows and begins his milking. The other milker drives the cows into a stable, with a cement floor, that has been thoroughly cleaned, he takes a damp cloth and wipes off the cows so that no dirt from them gets into the milk. He puts on a clean suit of overalls takes a pail that has just been sterilized, and washing his hands, goes to his milking. These pictures may seem like the two extremes but they are not impossible or improbable.

The man who milks the cows can be careful about getting dirt in the milk. The dairyman who bottles the milk should be careful of his work and the man who delivers it should do his part in seeing that every thing possible is done to keep the milk in good condition.

A man with a contagious disease may easily spread disease germs by handling milk. Bottles carelessly washed may carry disease germs. Human carriers may make milk unfit and may be just as much of a menace as unhealthy cows.

Sanitary Inspection of Dairies; Inspection of Cattle for Tuberculosis; Danger from Tuberculosis from Cattle.

In the country, people have their own cows and the people are directly responsible for the condition of their milk. It is their duty to see to it that the cows are healthy, that the milk pails are sterilized, the men who do the milking are clean and free from disease, and that the milk is properly cared for.

In small towns when people get milk from some neighbor who keeps a cow for his own use or from a near by farmer, the people should see to it personally that the milk they buy is good pure milk brought from sanitary places.

In the cities the problem is greater. The milk supply comes from farmers in every direction. It is brought to the city where it is cared for in dairies and from there sent out to the homes. It would be impossible for each family to see to it that the milk was pure. Health officers are appointed by the city to do this for us. They are to visit the dairies where our milk is bottled ready for use, to make sure that the milk is properly handled and

kept in clean places. These health officers must go even further and see to it that this milk comes from healthy cows. Tests are made regularly to see that the milk is up to standard in purity and richness.

Tuberculosis among cattle is not the same as among people but is a similar disease. Milk from cows with tuberculosis should never be used. Often times a cow with this disease is killed at once for will spread rapidly among a drove of cattle.

We now have what we call the tuberculin test for cattle and by means of this test, it is easy to determine whether a cow has tuberculosis. Some of the poison of the tuberculosis germ is injected into the cow. If the cow develops a fever in a short time, it shows that she has tuberculosis. All cows should be tested regularly for the disease.

If cows have tuberculosis they give infected milk which is dangerous to all who drink it.

Cows, like people, need proper care and good surroundings to be healthy. Stables should be kept clean and there should be good food and plenty of fresh air provided.

Tuberculosis germs in the milk are especially dangerous for children. From them they contract a disease very similar to that of the cows. However, a milker with tuberculosis may do more harm in spreading the disease than the cows with the disease.

Laws are made requiring that cows be tested regularly for tuberculosis so if proper care is exercised, the danger from cattle should not be very great.

The Keeping Qualities of Clean as Compared with Dirty Milk.

The keeping qualities of clean milk are much greater than that of dirty milk. The composition of milk is such that dirt may be contained in it but not be visible to the naked eye. A difference is noticed, however, in the keeping qualities.

Milk ordinarily sours quickly. Dirty milk is full of bacteria and because of that sours much more quickly than sweet milk.

Clean milk, if properly cared for will keep sweet a long time. It is said that we can produce milk so clean that it may be sent across the ocean and back and still be sweet.

Clean milk is preferable to dirty milk both because it keeps longer and because it is much more healthful.

Ice and the Keeping of Milk.

It is so important that milk be kept cold that in the cities where there are people who can not afford to buy ice, it is provided for them by different city institutions. Children must have milk and milk to be sweet and pure must be kept cold. Providing ice for the poor with small children, saves much in keeping disease from them.

Milk requires greater care than almost any other food. As soon as it is left at the door, it should be put into the refrigerator as close to the ice as possible, and it should always be kept covered. Food with strong odors such as onions and cabbage should be kept far from milk for it is easily tainted by these foods.

In warm weather milk sours quickly. This sour milk is dangerous for babies who take no food except milk.

Microbes are always present in milk. When milk is warm, these microbes multiply until they are countless numbers. As these microbes increase, they change the sugar in milk to an acid which gives the milk a sour taste.

These microbes that sour the milk are not harmful and sour milk is not a bad food for older people, but when there are disease germs in the milk and the milk is allowed to get warm, the germs multiply rapidly and the disease germs are harmful to people.

Milk should be kept cold for when it is cold the bacteria in it can not grow and the milk can be kept pure and sweet much longer.

A Trip of Inspection.

A trip of inspection to some high class dairy is suggested as being valuable to the pupils studying milk supply. It might be valuable too, to have the pupils observe practices that are unsanitary relative to milking and the care of milk and discuss them in class.

Compositions.

Composition subjects are suggested. Each will be discussed briefly:

Danger from unclean milk.—Milk is one of the greatest distributors of disease germs of all the foods. Milk is the most difficult of all foods to care for. There are so many chances for dirt to get into the milk. Dirt may come from the cow or from the milker when the cow is being milked; it may come from bottles that have not been washed clean; it may come from carelessness in delivering milk, and it may come from neglect in caring for it after it reaches the home.

Diseases such as tuberculosis, typhoid fever, diphtheria, or scarlet fever are so easily carried in the milk that great care should be taken to see to it that at all times milk is kept clean.

Cleanliness and the Milk Business.—Cleanliness and the milk business should go hand in hand. Cleanliness is so essential to the milk business that the board of health should be sure that milk is cared for under the most sanitary conditions and delivered to the homes as pure sweet milk. The housewife should then do her share towards keeping it clean until it is used by the family.

Under these conditions milk is a perfect food and should be used freely by all.

Healthy Cattle and our milk supply.—Milk is our most perfect food and even with the high prices, our cheapest food. A housewife should allow a pint of milk a day for each member of the family and growing boys and girls should have a quart. On the other hand milk requires greater care in handling than any other food. Considering the quantity we use, in comparison with any other food and the careful handling it requires to have the milk kept in good condition, we can see how necessary it is that our milk supply comes from healthy cows.

Cows require good food and surroundings the same as people do. Cows that live on the prairies where all is open and fresh air is abundant, are usually free from disease. Cows that are kept in stables and on pastures should be given the proper food and stables should be kept clean and should be light and airy. Then the cows will be healthy and give good pure milk.

We should see to it that our milk supply comes from such cows if we are interested in the welfare of our family.

FOOD SUPPLY.

A review will not be necessary as the work done in the earlier grades is covered for the most part in this discussion.

Need of Care in Handling Food Whether at Home or in Stores; Value of Trustworthiness and Honesty in Handling Food.

Food is anything that we take into our bodies as nourishment. In order that this food may be kept in good condition for our bodies, there is need of care in handling it whether at home or in the store. Only persons with clean hands and clean clothing should be allowed to handle food and when food is put away it should be kept in clean places protected from dirt and filth.

In stores the food should be kept covered and wrapped and carefully handled and in the homes care should be exercised in the same way.

Our bodies are protected from disease germs in that they can destroy a reasonable number of germs but in one bite of bad food there may be a great number of germs, even more than the body can destroy, so it is necessary that we take great care that the food we eat is good wholesome food.

We know that fresh fruits and vegetables have few bacteria and we know that when good food is in cold storage, bacteria does not grow and multiply. If we can have trustworthy-honest men handling our food supplies, who will not put unfit food on the market, our chances for pure food are good.

Lists of Foods That Are Most Likely to Become Contaminated With Disease Germs; Foods Eaten Uncooked are Generally the Most Dangerous.

All foods contain bacteria to a greater or less degree. Sometimes these bacteria are not harmful as the bacteria which sours milk and cream and prepares it for the making of cheese and butter. Fortunately if we have strong healthy bodies we can

fight and overcome some of the harmful disease germs. Some foods, especially when they are not in perfect condition, contain many disease germs, and these we should aim to avoid.

Milk should come first as one of the foods most likely to become contaminated with disease germs. The reasons for the frequent contamination of milk have been discussed fully in the section on "Milk Supply."

Meat would probably come next to milk in this list and lastly the fresh vegetables and fruits.

Other foods are sometimes contaminated with disease germs but these mentioned are the most likely ones.

Our bodies are like gas engines or steam engines. In the same way that these engines need fuel to make them do their work, we need food to make our bodies proficient. An inferior quality of fuel will keep the engine from doing good work and in the same way poor food will keep our bodies from being fit. Good food in the proper quantities is necessary to build up strong healthy bodies.

Man is the only animal that cooks his food. He does it because he has found that foods, eaten uncooked, are often dangerous.

We cook foods for various reasons. Cooking makes food more easily digested; it makes food more appetizing, and it detroys bacteria and parasites.

Some fruits and vegetables are eaten raw. At the present time there is a tendency to eat more of our vegetables, such as cabbage and carrots, without cooking. Cooking does destroy some element of the food that the body requires. In eating raw food, great care should be taken that the food is fresh and in good condition and that it has been thoroughly washed. Raw foods carry microbes to the alimentary canal but the number will be greatly lessened if the raw food is clean when we eat it.

Meats should always be cooked. Cooking is done in the case of meats not to make the food more digestible but to kill possible parasites in the meat. These parasites are found more frequently in pork than in any other meat.

Most states have laws requiring the inspection of animals used for food but there is enough carelessness in the handling of meat that the only safe way is to cook it.

While our bodies seem to require some of the raw foods, care must be taken in the use of them as uncooked foods are generally somewhat dangerous.

Poisoning from Protein Foods; Sanitary Methods of Delivering And Carrying Foods.

Proteins build up the tissues of our bodies. They are necessary in the diet but not in quantities. Proteins come from meat, eggs, milk and to some extent from cereals. Protein foods are among the more expensive.

These protein foods are not harmful in small quantities but if we eat meat too frequently, we get too much protein and this is thought to be one cause of kidney trouble. Parasites such as tapeworms and trichina are sometimes taken into the body by eating meats so care should be taken that all meats should be so very carefully inspected and thoroughly cooked.

If we are to be sure our food is pure, we must consider more than the grocery store from which it came. We should know something of the method of gathering it, how it was packed, and all the various processes it goes through before reaching our homes. Carelessness in any one of the processes may spoil the food.

Any food touched with human hands is dangerous. Haven't you seen a delivery man from a bakery stop to change his tire and then pick up an armful of unwrapped bread and carry it into a grocery store? Haven't you gone into a grocery store and had the clerk reach into a jar with his hands and count out your pickles before putting them into the container? The handling of any kinds of foodstuff should be done in a most sanitary way if we are going to escape these many disease germs that are all around us.

Care should be taken in the packing of meat, the wrapping of bread, the canning of fruits and vegetables and the milling of flour.

All foods should be delivered to us in the best possible condition.

Contamination of Foods From Polluted Soil Such as Celery and Radishes; Sanitary Grocery Stores.

In some places in the West they have what are called sewage farms. On these farms the sewage is run out over the ground, and is used as fertilizer. This makes a rich soil and seems safe for the growing of grains of different kinds and fruit but it is not safe for vegetables that are eaten raw such as celery, radishes etc.

A few years ago sanitary grocery stores were not at all frequent. Before people understood about bacteria there did not seem to be great need of carefulness. We liked to go into clean stores because the appearance of the place appealed to us but we didn't realize the great dangers in the stores that were not so clean.

Even in these days when we want the best possible food for our families, some stores are careless in their care of food. There are certain things we demand of our grocery stores now:

Goods that can not be washed before using should not be displayed in the open in the stores or on the side walks.

All bread should be wrapped. Bacteria on unwrapped bread is not especially dangerous but unclean bread is not attractive.

Flies should be kept away from all food for more filth is carried by flies than in almost any other way.

Overripe fruit and vegetables should not be sold. When fruit or vegetables begin to spoil, bacteria begin to grow and multiply so the articles are unfit for use.

Perishable goods should be kept in cold storage but foods that are beginning to spoil should not be placed in cold storage as things can not be benefitted by it. Perishable foods should be kept under glass or should be screened in and goods such as sugar and flour should be covered.

All meats should be inspected. Animals should first be examined, and then killed under sanitary conditions and kept in cold storage until used.

There are other things we could mention that are expected of a sanitary grocery store but enough have been mentioned to perhaps open our eyes to the need for good clean food if we want to keep strong and well.

Preserving of Foods by Sugar, Salt and Vinegar; Danger of Chemical Preservatives.

Food is often preserved when it is in season so that it can be used later. The safest and best preservers of food are sugar, salt and vinegar. Bacteria will not grow and increase in any of these.

If we make our preserves rich with sugar, even though the containers are not sealed, the fruit will keep a long time. Sugar is also used in preserving milk. In condensed milk, water is taken out and sugar added and this process will keep it indefinitely.

Salt is used especially in preserving fish and meat. We have the different kinds of salt fish, and salt pork but since the days of cold storage salt is not used as much in preserving meats.

Vinegar stops the growth of germs. If we prepare buttered beets they will keep only two or three days at the most, but if we pickle them, they will keep a long time. The same is true of other fruits and vegetables.

These preservatives, sugar, salt, and vinegar change the food but little and are the only safe ones to use.

Chemicals are often used to preserve foods. The requirements are that the chemicals used do preserve the food and that they do not harm it. Some chemicals preserve food but in themselves are harmful. An illustration of this is the use of formaldehyde to preserve milk. It keeps the milk sweet but the milk thus doctored is not healthful.

Alum, boracic acid and sulphites are used to preserve foods. Our pure food laws insist that when any such chemicals are used, the labels shall state the fact. It is not against the laws to use these chemicals and while a small amount is not particularly harmful, there is always the danger that too much will be used. It is always safer to read labels and if any chemical is used, avoid that particular brand of goods. We may get more of the chemical than our systems can take care of and be poisoned by it.

INSECTS AND SANITATION.

Insects as Disease Carriers. How House Flies Carry Germs.

Since the discovery of bacteria, it has been definitely determined that insects carry disease germs.

The mosquito is probably the insect most dreaded as it carries yellow fever and malaria. This particular kind of mosquito is commonly called the malaria mosquito. When it bites a person it injects the germs into him and so spreads the disease.

The housefly is known to be a great disease germ carrier. It spreads typhoid fever, diphtheria, smallpox and many other diseases. Some of these diseases are carried by flies from the wastes of the body and some from the filth in the streets.

The germ of the bubonic plague are spread by fleas. These fleas live on the bodies of rats and when the rats, that are subject to the plague, die the fleas leave their bodies and oftentimes bite some person and infects him with the plague. People in clean, well kept houses are not so likely to take this disease as those who are careless about the matters of cleanliness.

Other insects carry disease and the more we study this subject, the more we feel that all insects, such as roaches, bed bugs, flies etc., should never be allowed in our homes.

House flies are attracted to places where filth has accumulated and they carry germs from this filth to food that is left uncovered or to the dishes that are to be used for food. Flies may carry these germs to people who have sores or cuts and infest them. They may go to the barn yard where the milking is being done and carry germs directly to the milk.

It almost seems as though flies were made to carry germs. Every part of their bodies is so constructed that it can be simply covered with germs. The fly is small and the germs so minute that we can not see them. If we could see them, doubtless we would fear the fly more than some of us seem to do. When we see a fly buzzing around the room touching food and dishes here and there, if we just stop to consider where that fly may have been and the kind of germs he may be carrying, we will see to it that he is not allowed to stay near us.

It is so much easier to prevent disease than to cure it after it comes and when we consider how easily the fly can carry many kinds of disease germs from the filth and rubbish it has been crawling over, we will do all we can to destroy the fly.

Mosquitoes and Malaria.

Mosquitoes are directly responsible for malaria as the disease can be carried in no other way. The mosquito bites a person who has malaria and the germs from the blood of that person with malaria enter the mosquito. These malaria germs live and multiply in the mosquito and when it bites a second person, it leaves these malaria germs in the blood of the person.

The red corpuscles of a person with malaria are infected with a tiny one-celled animal. One of these will live in a red corpuscle for about three days. During this time it has been dividing and forming new one-celled animals. These crowd the corpuscle so that the wall of the corpuscle breaks and these little animals are set free in the blood. At this point the patient has a chill which is one of the early symptoms of malaria. These germs in the blood enter another red corpuscle and go through the same process of breaking the walls of the corpuscle and another chill follows.

Malaria is a dreaded disease. It may not seem to be of such a serious nature but it weakens a person and takes away his vitality so he is easily a victim to other diseases. The best prevention for malaria is to destroy the mosquito and then the disease will not be spread.

Life Histories of these Insects.

Mosquitoes lay their eggs on the surface of the water. In less than a day these eggs hatch and from each egg is a small insect we commonly call a wriggler. These wrigglers or larva grow for about a week and change into the pupa. In about three days more, the pupa becomes a full grown mosquito.

As a larva, the mosquito lives upon small living things he finds in the water, but when he becomes a full grown mosquito

he gets a greater part of his food from the blood of people or other animals.

Flies breed mostly in horse manure and also in body wastes and any animal or vegetable matter that is beginning to decay.

The fly, like the mosquito, has four stages of development. First is the egg which hatches in about a day, then as the larva for five or six days, then the pupa from five to seven days and finally the adult fly.

The female fly lays about one hundred and twenty eggs at a time and keeps this up from spring to late fall, sometimes as often as four times a season. There may be as many as eight or twelve generations in one season so you can see how rapidly they multiply and the need for the destruction of breeding places.

Destruction of Breeding Places the Most Effective Way to Control These Pests.

We hear the slogan "swat the fly" and we are urged to avoid places where mosquitoes are found, but the best course to take is to destroy their breeding places. We may kill one fly, and it is a good thing to do, but think of the great number that are breeding in the filth behind the barn and how much more we are accomplishing if we destroy the breeding places.

House flies breed so rapidly that we can not hope to do much towards eradicating them unless we start at the beginning, destroy their eggs before they develop and destroy their breeding places. This eradication and destruction is done by careful disposal of all garbage and filth that would attract flies. Everything that is thrown out that flies swarm around should either be screened from the flies or destroyed in some way.

Mosquitos breed in any place where there is stagnant water. It may be in a swampy place in the woods or in a small amount of water left in an old broken cup. Water should be drained away but if this is not possible, mosquitoes may be killed by pouring oil on the water. The oil kills the eggs and if the mosquitoes attempt to go through the oil, they are killed.

It seems rather a simple matter to destroy the breeding places of mosquitoes so if we are bothered with them, we may know it is due mostly to carelessness on our part.

Control of Malaria and Yellow Fever.

Malaria and yellow fever have been controlled by the destruction of the mosquito. Striking example of this fact are found in the freedom of Havana and Panama from these diseases.

When the Uuited States took possession of Havana at the time of the Cuban War, Havana had a fine harbor but it was filled with refuse. Throughout the city were open sewers where insects and animals could feed. Disease was everywhere and the death rate was appalling. The government began investigating the sanitary conditions of the city. The harbor was cleaned up and a better method for the disposal of sewage used. A new water supply was found and the sick were cared for so that disease germs were not carried. This general cleaning up destroyed the breeding places of the mosquitoes and Havana was made a healthy city.

When the United States began work on the Panama Canal, conditions similar to those found at Havana were prevalent. One of the first things the United States did was to secure the right to enforce health rules. Colonel Gorgas had gone to Havana after the Cuban War and made Havana a healthy city so he was now called to Panama. He looked after the drainage, paved the streets, secured pure drinking water and killed the flies and mosquitoes. After the place was made safe, men from all walks of life went there and work began under healthy conditions.

These two places, Havana and Panama, show what can be done in controlling disease by destruction of the mosquito.

Cleaning Up Campaign or Permanent Habits of Neatness.

Cleaning up campaigns are of value in communities, but it is better to develop permanent habits of neatness and of cleanliness about our premises.

When the sanitary conditions in a town are bad, a cleaning up campaign is a fine thing but people should take a pride in their town and try to keep it neat and clean at all times so that spasmodic campaigns are not needed.

The town authorities and the individuals should see to it that there is a regular and frequent disposal of garbage and that filth

of any kind is not allowed to accumulate. There is no use to start a campaign against flies and mosquitoes and leave their breeding places untouched. If each one is clean and neat about his premises and ordinances are passed to enforce regular and systematic cleaning, there will be no need for a cleaning up campaign.

Composition Work.

These compositions have been discussed in the above topics under Insects and Sanitation. The teacher can have the pupils use the points made and enlarge upon them.

BOARD OF HEALTH.

Need for a Board of Health. Duties.

When people of all classes live together in communities there is need for some organization to look after the health of the community. There are people who are careless and people who are ignorant and unless some one takes the responsibility for their welfare, disease will spread among them.

In cities are police departments organized to protect the people from those who disobey the laws and there are fire departments to protect the homes of the people from destruction, by fire. and health departments to protect the people from disease. When there is sickness, people call a physician to care for them and make them well. But we have the health department to protect them from disease and keep them well.

Disease can be spread by carelessness along the streets, in the schools and churches, in the moving picture shows and in other general meeting places. Disease can be spread by careless handling of milk and food and careless disposal of sewage.

Individuals can see about these things in their own homes but since not all can and will do it, it is necessary that we have a board of health to protect us from disease.

It will be easier to understand the duties of the board of health if we know something about the organization. We will discuss the organization briefly before explaining the duties.

In most cities the mayor appoints from three to nine men who

are to supervise the work of the department of health. Sometimes there are engineers and lawyers on the board but most of the members are physicians. These men organize the work and plan what shall be done. They do not give all of their time to the work and receive no pay for their services.

There is usually a health officer who is responsible for carrying out the plans of the board. He gives his entire time to the work and is paid for it. He is usually a physician and has others working under him.

The city health officer works only in the cities but as many people live outside in small towns and in the rural districts, it is necessary that there shall be some one who will look after their welfare, so a state health department is organized similar to the city department and their work is carried on all over the state.

Our national government has organized what is called the United States Public Health Service. Their duties are to protect the health of all the people and do the things which can be done only by the national government.

The work of the board of health is so important and covers so much ground that their duties are numerous.

We have learned in our study of bacteria that some diseases are spread by disease germs going from sick people to the bodies of well people and the health department must protect is from people having disease germs. People with contageous diseases usually call a physician who at once reports the case to the board of health. They see to it that precautions are taken to prevent the spread of disease and that the one who is sick has the proper care. Many people, ill with contageous diseases, are taken at once to a hospital where they may get the proper care and not expose any one. If they are kept at home a quarantine sign is placed on the house and no one is supposed to leave the house and no outsider should go into the house.

Evevry effort is made to keep contagious diseases out of the schools, for often times when a disease starts in the school most of the children take it. If a child in a family of several children comes down with diphtheria, the house is quarantined at once, and the children all kept there or those who do not have the disease taken to some other house but in that case these other child-

ren must be kept in until it is determined whether they are going to take the disease. If the child who has diphtheria was sick at school before he knew he had the disease, the children at school should be carefully watched and their throats examined every day.

In some cases the Schick test is used. A very little of the diptheria toxin is injected into the arm. If the person is immune from diphtheria, the toxin has almost no effect but if the person is not immune, the poison makes the skin a little red and inflamed. Those who are found susceptible to diphtheria should be made immune by the toxin—antitoxin treatment then there is no danger of contracting the disease. In some cities the health department has what may be called infant welfare stations to reduce infant mortality. Here mothers, who cannot afford a physician, may take their babies and be told just how to care for them, and how and what to feed them. If necessary the stations provide food for the children.

The health department is of valuable assistance to physicians. The department usually has laboratories where the physician can send samples of blood from the patient or some of the microbes from the body and have them examined to determine the disease the patient has. These laboratories also examine the water supply and the milk from the different dairies to determine whether they are pure.

The health department watches the food that is sold in the stores and inspects bakeries, meat markets and such places.

The state health department does work similar to that done in the cities except that its regulations apply to all the state. It works with the city departments to proect people's health.

The United States Public Health Service works with these other departments in protecting the health of the people in the states but a very important other work that it does is to prevent diseases from foreign countries from being brought to this country. All of these departments are studying to see what they can do to prevent disease and each assists the other in this work.

An important duty of these health departments is to collect statistics. Among these are the records of all births and deaths and many details in connection with the deaths to show facts relative to disease.

Their duties seem almost endless but this discussion will give you an idea of the work they are to do and the great value to our welfare of a board of health.

Co-operation with Board of Health.

Good citizens are always ready to help the government in enforcing its laws and regulations. People should do everything they can to co-operate with the board of health in its effort to protect people from disease. The board can quarantine a patient and do everything possible to prevent the patient from spreading the disease but if members of the family are careless and outsiders go into a house where there is a quarantine sign, the work of the board of health will come to naught. There is need of a hearty co-operation between the people and the board of health.

Isolation of Small Pox Patients.

Before the discovery of vaccination, smallpox was a disease much dreaded. It was very contageous. The patient was often loathsome when he was sick and often disfigured afterwards. Smallpox was so prevalent that people expected to have it. It sometimes caused blindness and there were many deaths from it. We still see some people who are pock-marked but not nearly so many as years ago.

Vaccination has greatly reduced the number of cases of smallpox but when it does occur, the disease is of such a serious nature that the patient should be isolated so the disease is not carried to others.

Quarantine and its Value.

Quarantine means the isolation of any person having or even suspected of having a contagious disease so that the disease may not be spread. People may be quarantined when they are exposed to the disease and kept under quarantine during disease and until there is no chance of carrying the disease to others.

People may be isolated by being sent to a hospital, by having the whole house quarantined, or by being kept in one room.

The idea of quarantine is to keep the patient away from other people.

Good Citizenship and Strict Observance of Quarantine; Vaccination and Its Value.

A good citizen will obey all laws whether he wants to or not. If a man with his family is quarantined for scarlet fever or some other serious disease, as a law abiding citizen, he should keep a strict observance of quarantine and not allow any one to leave the house or outsiders to come in until it is safe to do so.

Vaccination was discovered in 1796 by Dr. Jenner. The word vacca means a cow. Cows have a disease called cowpox which is similar to smallpox and the matter formed in this disease of the cow, when put under the skin of people keep people from getting smallpox even though they are exposed to it.

When we know what a horrible disease smallpox is and when we read what vaccination has done to lessen the number of cases of smallpox, there is no question as to its value.

Vaccination for smallpox has been used more than vaccination for other diseases so we understand more about its use for smallpox but physicians are now vaccinating for other diseases such as typhoid, diphtheria, and scarlet fever and vaccination will doubtless prove much more valuable as time goes on.

Why the Board of Health Has a Right to Enforce Vaccination. Tell About the Danger of Infection from Outside in Vaccination.

The board of health has a right to enforce vaccination just as much as our government has a right to enforce any law. The board of health is working for the good of the people and if vaccination has so greatly reduced smallpox, the board should have the right to enforce vaccination. In a great many of the schools vaccination is required. A few children after vaccination may have some trouble with infection if they are careless but probably

the trouble from all the vaccination in a dozen schools would not equal that of one case of smallpox.

There is always danger from infection in any wound. If disease germs come in contact with the vaccination scratch, infection results but if the wound is kept clean and properly cared for, there is very little danger.

Vaccination is Safe if the Wound is Properly Cared for.

Vaccination has been so universally and so successfully carried out that we need have no fear of it if proper vaccine is used and the arm properly cared for. The wound however should have the proper care or it may become infected like any other wound. Some physicians have the wound covered with sterile gauze which must be changed frequently. Other physicians ask that nothing be put over the wound but that the clothing which covers it be clean at all times. In either case the important thing is to keep the wound clean and try not to bruise the arm. A good scab should be formed over the sore and this scab comes off of its own free will when the wound heals.

DISPOSAL OF SEWAGE.

Importance of Proper Desposal of Sewage.

If we are interested in the health of the people, one of the most important things to consider is the proper disposal of sewage. Rubbish, garbage, and all body wastes are breeding places of disease germs and should have attention.

This question is usually given more attention in the cities than in the rural districts. This is because so many people live together in cities and as a result garbage and waste accumulations are greater, making it important that much care be used to protect the people. The sewage problem for the housewife in the city is simple for sewers are provided by the cities. There is usually an underground sewer in every street and every house is connected with it. All wastes from the bath room and kitchen sink goes into this. The garbage is kept in a covered pail and this is cared for by the city, so the problem is rather a simple one for the city housewife.

The problems of the small town or rural housewife will now be considered. By way of illustration, let us suppose Mrs. Jones lives in a country town where people are not crowded but where she has neighbors on each side of her. She throws her garbage out behind the barn. It is out of the way there and can not be seen from the house. This garbage will form a breeding place for flies and will supply enough for her and all her neighbors. She thinks dish water is harmless so throws it out over the yard. If the water sinks into the ground, there is not much danger though there will likely be odors from it, but if some of it happens to form a small pool Mrs. Jones will soon supply her neighbors with mosquitoes as well as flies. The Jones may have an outdoor toilet which can cause an endless amount of harm.

A modern bathroom is now built so it is attractive and most sanitary but sometimes it is not possible to have a bath room in a small town with no city water.

If an out door toilet is necessary it should be given the greatest care. Body wastes often contain many harmful bacteria and careless disposal of these wastes may cause the spread of disease. Out door toilets should be carefully screened. Lime should be mixed with earth and used to cover the waste material. Care should be taken that no well is near enough to be contaminated.

Many times city people, returning from a country vacation come down with typhoid fever simply because of carelessness in the disposal of sewage in the country.

Often country homes have their own individual plants for water supply and for sewage disposal. If properly constructed, these are ideal but if people can not afford these, then they should take the greatest possible care in the method of sewage disposal.

Dangerous Germs Present in Sewage. Means of Disposal. Pollution of Streams by Sewage.

Sewage is full of germs and most of them are dangerous. If sewage is properly cared for, there is no great danger but when people carelessly throw it out, there is danger. Open sewers are not found so much now but they are always dangerous. They carry sewage that is bacteria laden. Flies and mosquitoes have

access to this and feed upon it and scatter the germs. Dogs and rats also have access to it. Sewage in most any form carries disease germs and should never be carelessly disposed of.

Sewage should always be disposed of promptly. Wastes from the bath room and kitchen sink should be run into the sewer where the city cares for it, and garbage should be collected regularly and taken away in covered wagons.

There are different ways of disposal of sewage and some of these will be discussed:

In the country or in small towns, individuals must be responsible for the disposal of sewage. It is a good plan to burn as much of it as possible but all can not be burned. Many have their own cess pools but these need careful attention. The main thing is to see to it that it is not built near a well that is used for drinking water. If no well is nearer than seventy-five feet, it is comparatively safe, for in that distance the water from the cess pool would be filtered sufficiently so no danger would come from it.

In some places in the West they have what are called sewage farms. The sewage is taken to these farms and scattered over the soil. In this are many bacteria but not all of them are harmful. There are some that cause the oxygen of the air to unite with the animal and vegetable tissues. When the sewage is scattered over the soil these bacteria begin their work, and the soil is made fertile and can be used for growing fruit and grain, but is unfit for growing some kinds of vegetables.

Cities have various ways of disposing of their sewage. An ideal way is to burn all rubbish and refuse. Some cities have plants for this purpose.

Some cities aerate the sewage and then run it into a stream. Solids are removed, and the liquids sprayed into the air and then thrown over a layer of coke and after seeping through this, run into a stream.

Other cities have large septic tanks where the water is allowed to seep through. These tanks are built of brick or concrete and are water tight. The tanks are divided into compartments through which the sewage moves slowly. The organic

wastes are broken up and a kind of bacteria which can live only away from the air, helps to take the wastes away. Mud forms at the bottom of the tank and this must be cleaned away but only when quantities of it have collected. After this process, it is harmless and can be run into a stream without polluting the stream.

Sometimes the oil and grease are taken out to be used in the making of soap and the remainder is used for fertilizer.

For the sake of health, all sewage should be disposed of in some efficient and sanitary way.

Means of disposal of sewage have been fully discussed in the preceeding topic. Carelessness in any of these, means when the sewage is disposed of near a stream, will pollute that stream.

Danger of Obtaining Water from Small Streams in Thickly Populated Regions.

The problem of water supply is an important one. Water is so esential for drinking purposes as well as for many other uses. If public health is to be considered, we must be sure that our water supply does not come from some contaminated stream. There is always danger in obtaining water from small streams in thickly populated regions. Suppose a town gets its water from a stream that is crowded on both sides with small towns. A reasonable amount of sewage may be thrown into a stream and the stream be able to purify it but if there are people living all along the stream, so much sewage would be thrown in that the water would be unfit for use.

Though there might be regulations forbidding people to throw anything in the river, we can not depend on all people. If there are many living along the stream there is bound to be some who would not obey the regulation. If such an ideal condition could exist, where no rubbish or refuse of any kind was thrown in, enough would be thrown on the ground and into cess pools to seep into the stream so the only safe way would be to see to it that the water is filtered or purified in some way before it is used.

"Swimming Holes" and Polluted Streams. Danger of Disease Transmission from Swimming Pools.

Polluted streams are not safe for swimming holes. If the water in the stream is filled with impurities persons going swimming in these places would come in contact with some of the impurities, and disease germs from the polluted stream could easily enter their bodies.

Swimming pools should have strict regulations with regard to the water in the pool. The water should either be changed frequently or so filled that the water is changing constantly. Suppose a boy who is coming down with some contagious disease would go into the pool. He would give off disease germs and if the water were not changed, other boys would come in contact with the germs. If the water is changing constantly the danger is greatly lessened.

Flies and Sewage Desposal; Contamination of Milk, and other Foods from Exposed Sewage.

The greatest care should be taken in disposing of sewage so that it is not left where flies can reach it.

Some housewives think if garbage is thrown out of sight, some distance from the house, it will do no harm, but no matter where it is thrown, it will soon decay and be a breeding place for flies. They, in turn, will carry germs and filth back to the house.

Sewage that is thrown out begins at once to decay and give off harmful germs. If the sewage is near the house, the germs may be carried through the air to the food and milk and contaminate them or if the sewage is thrown some distance away the germs may be carried to the food by means of flies. Our food should be kept as free from disease germs as possible and exposed sewage should be kept far away.

FIRST AID.

Importance of Knowing What To Do in Accidents and Emergencies. Self Control in Emergancies.

We expect physicians to know what to do in illness but when accidents and emergencies occur, we should know what to do.

The first step is to summon a physician and then care for the injured one as best we can until the physician arrives. Common sense and a first aid kit would be valuable to have at such a time. We must not do anything that would harm the person but we should relieve him as best we can until help comes.

It is usually the unexpected that happens, and when emergencies come, we do not always know the best course to take. There may be an accident in which some one is hurt and we do not know the nature of his injury. If we get excited and lose self-control we are of no use to the injured one and may even do him harm by our excitement. The first thing to do when an accident occurs is to gain control of ourselves and then set about to do all we can for the one who has been injured until some one comes who can, with better knowledge and skill, take the case in hand. If we have self control when the accident occurs and later when the physician arrives, we may be of more value in the case then we would be if we knew much about first aid but had no self control.

First Aid Work Should be Strongly Emphasized.

Everyone should know something about first aid work. Since the World War people have taken much more interest in "First Aid" than ever before and courses have been given in it so that people generally know something about the subject. A teacher who has a room full of children under her care, will find her knowledge of first aid valuable and whether she studies into the subject to any extent, she should at least know some of the more simple rules.

Suppose it is winter and the school children are coasting down a hill in front of the school house. Two sleds run into each other and a small boy comes in with a cut on his arm. The first thing to do is to cleanse the wound. Your hands should be clean but even then you should never touch the wound. If the wound is not deep, it may be washed with pure soap and water that has been boiled though cooled so it will not burn the skin. After the wound is washed, you might pour some tincture of

Iodine into it and cover with a dressing of sterilized gauze. Over this place a bandage held in place by adhesive tape. The greatest care should be exercised so that the part of the sterilized dressing has touched nothing else before it is put over the wound. If you have no sterilized gauze on hand, a clean cloth may be sterilized by ironing it with a hot iron, or boiling cloth in water and then wringing it out. Care should be taken in dressing any cut or open sore that nothing which has germs on it, touch the wound or there is danger of infection.

FOURTH QUARTER.

The course of study says, "The outline for this quarter is given under Science and Agriculture. Therefore, the teacher must see to it that pupils review the topics in Science and Agriculture that has a bearing upon Health Education. Do this before you take up the work on Foods, etc.

Human Carriers of Disease.

During our first quarter, we had a brief review of our bodily structure, and the relation of human health to our environment. During the second quarter, we studied enemies to our health and well being. In the third quarter, we discussed fully the questions of milk and water supply, also food sources and care in handling. In our fourth quarter, we will take up more fully the question of our food, and the study of our five senses—touch, sight, smell, hearing and taste.

Some cynic has said that food is man's best friend or his worst enemy. This is true. The human body can not retain its efficiency for any great length of time without food, yet the contention of many physicians is equally true—that we dig our graves with our teeth.

The word food may be applied to any substance, either liquid or solid which nourishes the body. However, the word in its strictest application cannot apply to everything eaten, for many things taken into the stomach are not only of no benefit to bodily nourishment, but are genuinely harmful. Ordinarily when we mention food, we think of anything which is suitable to eat. That which is not used in body nourishment is waste, and as such is cast out.

The general term used to describe the use of food by the body is nutrition.

Nutrition in its broadest sense is a very comprehensive term and includes all the changes that take place in our bodies from the

time we take a bite of anything until that substance is cast out of our bodies as waste matter. Therefore, we can readily see that all the processes of digestion, absorption, circulation, assimilation, respiration (as concerned with oxidation) and excretion are included in this one term.

These six processes may be divided into the *upbuilding* and *destructive processes.* The first four belongs to the upbuilding or creative class. While the last two are destructive or tearing down processes.

Two Functions of Food.

The body has been compared to an engine, but unlike an engine, it requires food or fuel for a twofold purpose—*the first to furnish heat or energy and the second to repair waste all over the body.* The first need we have all felt on a cold day. When hungry we grow cold much quicker, as well as tired much sooner. In the second place, the body, unlike other engines, repairs its own worn out parts, and herein lies the second necessity for food. To this latter class may be added the foods needed by young children which not only repair the body's waste, but also cause growth and development.

Classes of Foods.

There are four distinct classes of foods:

1. Proteids or nitrogenous or albuminous.
2. Carbohydrates or starches and sugars.
3. The fats and oils.
4. Inorganic or minerals.

Proteids or Nitrogenous or Albuminous.

The proteids, nitrogenous or albuminous foods supply nitrogen which builds up and repairs the tissues of the body. Protein is found in several forms each differing in composition. Just how the different forms supply nitrogen suited to different bodily needs is still a matter of discussion among scientists. For this reason it is safest and best to supply protein to the body in various forms and seems to explain the general craving in man for a mixed diet.

Articles of food from both the animal and vegetable kingdoms contain protein. We find it in fish, milk, eggs, meats, cereals, legumes, and nuts. Protein foods besides building up the tissues also supplies energy for the body. But in order that our protein diet may largely be energy producing, fats, sugars, and starches must be limited.

Carbohydrates or Starches and Sugars.

The carbohydrates are so called because in this class of food we find the two chemical elements, carbon and hydrogen. The type of this group is sugar and starch, and although we could not live on carbohydrates alone, we really need a larger amount of this kind of food than of proteids.

The use of the carbohydrates is chiefly to give us force and heat. It is quite sure that if anyone consumes the albuminous foods, together with the carbohydrates, they are very liable to grow fat.

In the carbohydrate class of foods, we find the starches and sugars. Most of our vegetables are very rich in sugar; such as sugar cane, the beet, and the ripe fruits, such as the grape, apricot and plum. Sugar, like starch, is a heat producer, but it is very unlike it in taste.

There are four different kinds of sugar, but in spite of the difference in their taste, all are equally valuable to the body as food. Beet and cane sugar are the ones most commonly found on the market, but a cheaper form, known as glucose or grape sugar, is often used for adulterating purposes. It is found in fruits and is less sweet than cane or beet sugar. Milk sugar is another form and is found in milk alone. Starch and sugar while very unlike in appearance and taste, have much in common. The starch that is found in green fruits is changed to sugar by ripening, and just this same process takes place in the stomach when starch is digested. Potatoes and cereals furnish the greater part of our starch.

The Fats and Oils.

The fats and oils constitute the third class of foods. They are found in both the animal and vegetable kingdoms.

Butter, lard, and tallow are made from animal fats, while cotton seed oil and olive oil are products of the vegetable kingdom. Some of the oils, like lard, become solid when removed from the heat, but others, like olive oil, are in a liquid state. The fats are chiefly useful in maintaining the heat of the body, for it is well known that the inhabitants of northern and cold climates are accustomed to consume enormous quantities of fatty material. As has been said, the Eskimo in his snow house enjoys a tallow candle with all the relish that his Hindu brother would enjoy a lucious ripe banana. Besides furnishing heat for the body, the fats also furnish two and one-half times as much energy as either protein or carbohydrate food.

Inorganic or Mineral Foods; Water, Salts, Etc.

In addition to the other classes of food, there is another very necessary class. This is known as the inorganic or mineral foods. In this class we may include water, salt, lime, magnesia and other forms of minerals used in building up the body. All of our foods are composed largely of water, and if it were made perfectly free from the water it would be surprising to see how greatly the bulk would be diminished. Water justly ranks as a food because it enters into the composition of every tissue, even the bones and teeth. The bodily temperature is regulated by it, and in all muscular and nervous work it plays a most important part. It has been estimated that two-thirds of the entire body—enough if rightly arranged—to drown a person and since it is constantly passing from the body as excrement of the skin and kidneys, and from our lungs when we breathe, one can readily see how necessary it is that the supply be constant and pure. When our foods appear on the table, they are about one-half water, and yet they cannot supply all the body needs. For this reason, we must drink between meals. But as water is one of the best known sources of disease, the greatest care should be exercised in seeing that the water supply is free from all contamination. Vegetables are one of our greatest sources of water supply. Turnips are very little else than water, as are cabbage, lettuce, and radishes.

Salts and most mineral foods are taken as condiments largely and are absolutely indispensable to the nourishment of the body.

They perform two very valuable functions—body building and aiding in the chemical reactions. Among the many kinds used by the system, the most important are calcium (lime) salts, which are valuable for bone formation. Milk, eggs, cereals, and vegetables contain these in abundance. This class of salts are especially valuable to growing children, and great care should be used to see that children's diet is rich in this class of foods.

The abnormal appetitie which some children show in eating chalk, plaster or wood is due to a lack of calcium. This lack also results in small bones and poor teeth.

Sodium chloride or common salt is found in every tissue of the body except the enamel of the teeth, hence is an important factor in our food supply. So strong is the demand of the body for salt that animals of the forests will travel for miles to places where they may obtain salt—known as "salt lick," and in some parts of Africa where salt is scarce, men will barter their children for even a little of this substance.

Salts of iron are another very important salt found in our body. These are found in nearly all foods, and beef, oatmeal, eggs and some of the green vegetables are especially rich in them. Iron is very important in the blood, for it makes oxygen carrying possible in the hemoglobin.

In addition to these mentioned there are other salts of minor importance found in the body. Among these might be mentioned salts of potash. These minor salts aid in many ways, such as giving hardness to the teeth and bones and in various chemical reactions in the body, some of which are not clearly understood by scientists.

Sources of Proteid and Simple Tests for It.

In reviewing the four classes of foods, we find that proteids are obtained largely from animal foods. They are found in their most concentrated form in lean meat and eggs. Gluten in flour and casein in milk also furnish important varieties of this same food. There are many simple tests which may be made to show this class of food. Take the white of an egg; pour boiling water over it, and note with what rapidity it "sets"

or coagulates. Or, take a bit of the same white, or tiny piece of lean meat and drop it on a hot stove. Note the characteristic offensive odor with which it burns.

Sources of Carbohydrates and a Simple Test for It.

The carbohydrates constitute the starch and sugar class, and as has been said, are obtained largely from vegetables. The sugar in milk—known as milk sugar—is one very important exception to this rule.

One of the simplest tests made for starch is made with iodine solution. The article to be tested is simply touched with the solution. If starch is present, a blue or purplish color will appear.

Sources of Fats and Oils and Simple Tests for Them.

Fats and oils are obtained both from the vegetable and animal kingdoms. Lard, butter, and tallow are animal products, while cotton seed and olive oil, as well as the oils obtained from various nuts, are of the vegetable kingdom.

There are many simple tests for fats and oils. Take a piece of butter or suet, drop it on a hot stove and the rapidity with which it ignites shows its only nature. Or, take nut meats, mash them on paper and note the grease marks that remain.

Sources of the Inorganic or Mineral Foods and Tests for It.

The inorganic or mineral foods are taken as condiments largely, but are also found in almost every article of our daily diet.

If water is boiled until none of it remains in the pan, a white sediment will be noticed showing that lime and various other minerals had been held in partial solution in the water.

The tests for minerals in the foods are rather more complicated in the main than the tests for other food elements, the results of such tests depending upon certain chemical reactions and therefor not easily performed by the average pupil.

How the Different Foods Serve the Body.

The chief uses of the proteids or nitrogenous or albuminous foods are to *build up the body and repair waste of the tissues.*

The carbohydrates or sugars and starches are to *give us force and heat.*

The fats and oils *are really the fuel of the body,* for they furnish us with the means of maintaining our bodily temperature. For this reason, this class of food is much more necessary to the dwellers in cold regions than to the inhabitants of the warm climates.

Mineral foods have various uses in the body. Some of them *give hardness to the teeth and bones,* others *aid in the processes of digestion,* while the various uses of water by the human system vary from *helping eliminate waste products to oxidation of the blood.*

Proportion of Each Class of Food Found in Meat.

Meats include the flesh of all animals used as food by human beings, but only the more commonly used will be considered here. These are beef, pork, mutton, fowl, and fish. Meats are most important and a generally used source of *protein. They are rich in albumen* and also contain *fat* and *mineral matters.* An ordinary serving of meat once a day is all that is necessary. Indeed, too rich a diet of meat throws too great a strain upon the digestive arrangement, and may lead to serious bodily disorder, such as hardening of the arteries, kidney trouble, and serious intestinal diseases. Therefore, a part of our supply of protein should be obtained from eggs and milk. Gelatin and albumen are the principal proteins found in meat. The former is extracted from the connective tissue by the long slow application of heat with moisture, while the latter is hardened by intense heat. The protein from meat is more readily digested and absorbed by the body than is the protein from the vegetable kingdom. Perhaps this is due to the fact that it is more similar to the body-protein structure. The cuts of meats from the same beef or hog vary in composition. Those muscles which are exercised slightly will have more fat than lean, and thus the composition will vary. Analysis of lean beef has shown it to contain 70% of *water,* 21.3% of *protein,* 7.9% of *fat,* 1.1% of *ash* and it has a food value of 730 calories per pound. *Dried beef* varies somewhat—

having *less water,* 54.3%; *more protein,* 30%; *less fat,* 6.5%; *a slight trace of carbohydrates,* 4/10%; *a greater amount of ash,* 9.1%; and greater food value in calories, 840 per pound.

From the above it will be seen that all meat contains a relatively large per cent of water, and while it makes it easier to swallow than if it were dry, *the water contained in meat has not greater food value than water found anywhere else, hence the greater amount of water found in any cut of meat, the less its food value.* For this reason, fish and oysters are less nutritious than other meats. As a general rule, the more fat on a cut of meat, the less water it will contain. A lean cut of meat will or may contain 75% of water, while a fat cut from the same animal may contain 50% or even less.

All meat contains more or less fat. Very lean meat, like dried beef, may contain as little as 3%, while very fat pork contains about 90%. Fat is a very valuable constituent in meat, for it is the most concentrated form in which the fuel constituents of food are found. It has a fuel value of 2½ times that of protein or the carbohydrates. Lean meat has about 20% of protein for its weight about five times as much as milk. The flesh of wild fowl has generally more protein than beef, but fish has less. Meats contain but a small quantity of carbohydrates—only a fraction of 1%, and that mainly in the form of glycogen or muscle sugar. *Meats contain some mineral matters* (ash) *the most important of which are phosphates of lime, potash, and magnesia.*

Proportion of Each Class of Food Found in Milk and Eggs.

Milk and eggs are extremely important foods, especially in the diet of children or sick people. Milk contains no starch, but is rich in milk sugar, while eggs contain almost not carbohydrates. Both eggs and milk may be taken without cooking, but for most people eggs are rendered more palatable by cooking, while because of the possible bacteria it may contain, milk is also rendered safer by boiling. Eggs and milk, like meats and all foods rich in protein, should be cooked slowly and at a low temperature in order that they may be soft and easily digested. By test, milk has been found to have 87% of *water,* 3.5% *pro-*

tein, 4.4% *fat,* 5% *carbohydrates,* .7% *ash,* with a food value of 325 calories per pound. Cheese has 34.2% *water,* 25.9% *protein,* 33.7% *fat,* 2.4% *carbohydrates,* 3.8% *ash,* and 1.950 calories food value per pound. Butter has 11% *water,* 1% *protein,* 85% *fat,* 3% *ash,* with the *highest value in calories per pound of any food, 3,605.* Eggs have 73.7% *water,* 14.8 % *protein,* 10.5 *fat,* 1% *ash,* and 720 calories per pound food value.

Milk, the "perfect food," contains all the food elements—*water, fat, sugar, mineral,* and *albumen.* It will support life longer than any other known food. Milk may be the chief diet of a child until its first teeth come, but as it does not furnish enough force-producing material, this must be supplied by starchy foods, such as bread or crackers. Often milk is a source of danger in that it holds and transmits certain disease germs. For this reason, *great care should be used in selecting our dairy.* After the milk is brought to our homes, absolute cleanliness must be observed in caring for it. It is much safer to *scald all milk before it is used.* Milk that has been boiled is not so easily digested as that which has been merely scalded. The fat of milk is really the most important constituent of milk since it is the source of butter and is found in large quantities in cheese. The fat of milk known as butter fat consists of several different kinds of fat, the principle ones being stearin, palmitin and olein. These are the same that make up the bulk of meat fats—suet, tallow, lard, etc. Lactose or milk sugar is the chief carbohydrate found in milk. This sugar varies in amount from 466% of the total milk. *The manufacture of milk sugar from whey is an important industry, as it is much used by chemists in the making of powders, tablets, etc.* The ash in milk is mainly phosphates, and chlorides of soda, potash, and lime.

Protein and fat are the chief nutrients in eggs. Water and ash are also found. The white contains about twice as much water as the yolk, and less protein. Their water content as a whole is much the same as that of lean meat. The chief ash is common salt. Sulphur is found in the egg albumen. This is the substance when decomposed that gives spoilt eggs their offensive odor.

Proportion of Each Class of Food Found in Vegetables.

Vegetables, except peas, beans and other legumes, are usually poor in fat and protein, but are valuable as nutrients, largely because of their *carbohydrates.* Starch, cellulose and small amounts of sugar form the main carbohydrates elements. They are also *rich in mineral elements,* containing relatively large proportions of these. As vegetables are for the most part *one-half water, their food value is small compared to their bulk.* The legumes—beans, peas, lentils, and cowpeas, contain a much greater amount of *protein* than other vegetables, and most of them are also rich in *carbohydrates.* They are also rich in *iron, calcium, salts, potassium* and *phosphorus.* Next to the cereals the legumes are the most valuable and most widely used of all vegetable foods. They are found in all climates. The chief legumes used in the U. S. are peas, beans, and peanuts. Lentils are raised only to a limited extent in the southwest, although they are much more widely known in Europe and Asia.

Should we judge of a food by chemical analysis alone, we should be forced to give legumes the highest place among foods, since they contain more protein than even the best cuts of meat, but the ease and completeness with which a food is digested must be taken into consideration also. When these are considered, legumes do not rank so high, for their digestion is less complete, and in the case of persons not engaged in active work, is often attended by distress due to fermentation in the intestines.

Proportion of Each Class of Food Found in Cereals.

Cereals vary as to the proportion of nutrients, but *carbohydrates* predominate in them all. The carbohydrates are mainly in the form of starch. These starch grains are stored up in cells whose walls are tough cellulose.

Much of our cereals are products of wheat, corn, oats, and rye. Wheat is mainly ground into flour and comes to the table as bread or pastries. There are several varieties of flour, depending upon how much of the wheat grain is used. The whole grain is used in making Graham flour. *The food value of Graham flour is greater than that of white flour, because of the presence of the growing germ which is high in fat,* compared to

the rest of the wheat grain. *It also contains* a larger amount of *valuable minerals.* Pastry flour is made from winter wheat, which contains less gluten than spring wheat, which is used for bread making flour. Different specimens of the same grain may vary greatly in composition. This variation is caused by the variety, soil, climate, and season in which they grow. *While the different cereals resemble each other closely, and are all rich in carbohydrates, they have certain differences which separate them. Corn is rich in fats* compared to the others, while *oats are rich in both protein and fats. Rice has little fat* and little crude fiber, while both *rye and wheat have a high proportion of protein* and some small amount of fat. Oats furnishes the best balanced proportion of all grains, while wheat ranks next, and corn third.

For many children cereal foods are especially valuable. This is not alone because of their food value, but for the milk and sugar with which they are served. Cereals are also, because of their easy digestion, valuable for old people's diet. In cookery for invalids they are almost invaluable, but taken as a class, cereals (breakfast foods) are not as economical a diet for hearty working people as are grains served in the form of breads and pastries.

Proportion of Each Class of Food Found in Fruits.

While *most of our fruits contain starch and sugar,* according to their bulk, they perhaps form less of real value to our diet than most other of our foods. They are, however, useful to stimulate the appetite, and give a relish to our more substantial foods. They serve to give a piquancy to our heavy diet, and by their acid tend to overcome some of the evil effects of over eating of foods rich in fats and proteins. *They are rich in minerals,* and *after drying are much richer in grape than other sugars.* This is especially true of dates, raisins, figs, and prunes, which contain from 50% to 75% more sugar after drying. Not only are the acids and salts of benefit to the diet, but *the bulk of water and cellulose or woody fiber which they contain are of great benefit to stimulate the work of digestion.* Some of the dried fruits as well as fruit juices are valuable because of their

laxative properties. Ripe fruits contain much more sugar than green, for in the process of ripening the starches and other carbohydrates are changed into sugar.

Proportion of Each Class of Food Found in Beverages.

One of the peculiarities of the human appetite is that while most of the water we drink is taken in the form of beverages, we have no natural instinct or appetite for them. No child was ever born with a natural liking for beer or whisky and very few children like tea or coffee at first.

It seems that nature has attempted to show us that such drinks are by no means necessary or even beneficial to the human system. The most commonly used of these amusement food are tea, coffee, and cocoa. They have an agreeable taste, mildly stimulate the nervous system and while moderately used by grown up persons, seldom do much harm.

Tea is made from the green leaves of a shrub grown in China, Japan, and Southern India. Coffee is made from the seeds of a shrub or low tree. Much of our coffee comes from South America. Cocoa is made from the bean-like seeds of a small tree growing in the tropics. Unless made with milk, cocoa contains very little real food value. The effect of these three drinks depends upon a spicy tasting substance known as caffein. Unless taken to excess the mild stimulating effect produced upon the nervous system and heart may be beneficial, but if taken in large quantities without other food, may lead to serious disorders of the digestive system. The most harmful substance found in these beverages is tannin, but this will not be found unless the tea or coffee has been boiled and then left standing on the grounds. However, these drinks form a very small part of a nourishing diet and for children or young people are far better if left alone.

Among the amusement drinks which we cannot class as harmless are wine, ale, beer, whisky, brandy, and rum. Wine is produced by yeast bacteria working in a vat of grape juice. It attacks the fruit sugar contained in the juice, splits it up into alcohol and carbon dioxide, so that it becomes bubbly and frothy with gas. Beer, ale, and cider are made from crushed barley or

wheat and apples, which have been set to work by the yeast germ.

Whisky, brandy, and rum are made from distilling the mixture of water and alcohol made from grain or fruit juice.

Alcohol, if properly classed, would be put among the drugs and not among the foods. The greatest amount of alcohol which one could safely consume would supply less than one-tenth of the total fuel food necessary. Its effects on the body is a deadening one—much as morphine, ether, or chloral. The bodily condition may remain the same, but it deadens the nerves to any sense of discomfort from which one may be suffering.

At the present there are on the market many coffee and tea substitutes, but as these are for the most part made from cereals, they might have been properly discussed under that heading. The manufacturers claim that they make a harmless, satisfying drink, and are equal in flavor to coffee and tea, but this, the real coffee lover strenuously denies. *The real food value of most drinks is very small, except cocoa, which owes its real food value to the milk with which it is made. Fruit drinks owe their food value largely to the syrups used in their making.*

Principles of Selection of Food.

Three things have much importance in helping us instinctively to choose foods best suited to our individual needs. These are *climate, occupation* and *water.*

Animal food is much better suited to a cold than a hot climate. The internal fires burn up more fuel, for we breathe more rapidly and take in more oxygen in cold than in warm weather.

The sugar and starch obtained from fruits and vegetables are easily digested. The Eskimo lives largely on blubber oil. The Norwegians, Swedes and other persons of the far North use large quantities of oily fish, while in hot climates, as in India and Southern China, the main diet is rice. The Arab's diet consists mainly of dates, parched grains, and camel's milk. To these the Turk adds melons and cucumberes. As the Italians are farther north, we naturally expect to find a heavier diet, and this is true, for this is the country of marcaroni, cheese, and chestnuts.

Strange as it may seem, the water of a country helps to determine the nature of its food requirements. In Ireland, the water, strongly loaded with lime, furnishes what the potato lacks. In England and Scotland, where the waters are soft, oats and wheat, which are rich in phosphates, are the principal diet.

The craving of the natural instinct to obtain the elements—proteids, carbohydrates, fats and oils, and mineral foods—leads us to select such foods as will combine them in right proportion. In the spring, our appetites demand fresh fruits and vegetables so that the potash salts which have been lacking in our heavy winter diet, may be supplied. Our occupation also has much to do in determining the needs of the body for food. People engaged in sedentary occupation need food which may be served in an attractive form. They also must have the greatest nourishment in the most compact form. They should have animal food and starchy and warmth-giving foods. But people who work in the open prefer food which will stay by them. They prefer salt meat because it makes them drink more, and this supplies water necessary for excessive perspiration.

The choosing of foods and the planning of meals lies largely in the hands of the housekeeper. For this reason, *it is highly important that she have some very definite knowledge of food values.* Fortunately, the body readily adapts itself to the various kinds of food offered, selecting such as it needs for its work, but should a diet be consistently day by day either over rich or under value in any important food compound, the result will soon tell. For the average housekeeper it is almost if not quite impossible for her to have a perfectly balanced diet, but by careful planning a happy menu may be reached. A man weighing 150 pounds engaged in active work should have 3½ ounces of protein a day. A woman needs about 4/5 of that amount, while growing children need more in comparison to their size. The more active a life one lives the more food he will require. In this case, it is often well to increase the use of food rich in fats, starches, and sugar rather than those high in protein. Tests have proven that any meal which furnishes enough energy to the body will furnish enough protein.

Necessity for Indigestible Matter in Food.

Some foods are valuable to the proper working of the various organs of the body which viewed from the point of their assimilation into the body, cannot be classed as foods at all. These foods are those which give bulk to the more concentrated diet or those which are laxative in nature.

Of this class, bran is one of the most important and is highly recommended by physicians as a means of relief from constipation. Among the latter class, although these also have real food value, may be mentioned oranges, lemons, grape fruit, apples, prunes, figs, green vegetables, honey, molasses, olive oil, buttermilk, cream, butter, and oatmeal. To the first class may also be added all whole grain breads and fruits, if eaten without peeling.

Experiments have been conducted along this line very extensively and while they tend to prove that a too concentrated diet is by no means desirable, they have also proved that the presence of bran and such "roughage" tend to lessen the amount of nutrients digested. They showed that for persons troubled with constipation, bran served to increase the churning motion of the intestines, and tended to cause the food to pass on before it was wholly digested. For this reason, such foods should be used by invalids only at their physician's orders, but for the ordinary healthy person, inclination and taste may safely decide for one.

Hygiene of Digestion, Principles Governing Selection of Food, Conditions Affecting Choice, as Activity, Temperature, Age.

Individual tastes and physiological dissimilarities will always play an important part in the choice of food eaten, and dieticians must take these into consideration when planning menus. These peculiarities are not only individual, but national, so true, indeed is this that we have come to associate certain articles of diet with certain nations. The Englishman and his tea, the Russian and his caviare, the Italian and his spaghetti, the Frenchman and his salads and soups are too well known to need comment.

But *as national tastes differ as do individual tastes, the human system needs certain elements for its upkeep. These vary*

according to the age, activity, temperature, and climatic conditions. But should conditions be normal, the average adult will require about fourteen ounces of meat, sixteen ounces of bread, and three or four ounces of butter fat. In addition to this the body needs about fifty ounces of water during the day. In order to build up the body and repair its waste, and furnish the necessary amount of heat, a certain amount of each food element is indispensible. For example, about four and one-half ounces of albumin, four ounces of fat, and five ounces of sugar or starch must be eaten daily. To oxidize this amount of food will require a certain amount of oxygen. It has been estimated that in the course of a day a person breathes in about twenty-four ounces of oxygen which is sufficient to oxidize the quantities of the food elements that have been mentioned. Something should now be said of the kinds of foods the body needs. There is a real need for variety aside from mere preference. For example, we must have water, salt and lime compounds, starchy foods, fats, and a definite amount of nitrogenous foods. Should any of these be lacking, the body will soon feel the need of it. Sometimes this is shown by a peculiar craving for some things. Undernourishment is quite frequently found in the congested districts of our large cities, where Saint Vitus Dance, Rickets and kindred diseases run rife. But even in the homes of the wealthy are often found improperly nourished children. The majority of people do not eat a balanced diet. Ordinarily, the most simple meals come nearer containing all the necessary food elements than do the more elaborate ones. A meal consisting of bread, meat or cheese, eggs, butter and milk, will furnish all the necessary food elements.

When a housekeeper faces the problem of feeding old people, active, working middle aged people and children, all at the same time, her problem is no simple one.

A growing girl or boy requires more food than an adult. The reason is evident for *the child's worn tissues must be repaired and also extra food is needed to provide for the growth of the tissues. At no time of life is food oxidation so great as in childhood. Children are constantly in motion during their waking period.*

Experiments have shown that a child two and one-half years old, weighing twenty-five pounds, uses when at rest half as much oxygen as an adult weighing one hundred fifty pounds and nearly three times as much for each unit of weight. After seventy or seventy-five has been passed, there is a marked decrease in vitality and bodily activity. The food eaten is accordingly diminished. *Oxidation has been found to be about 20% less with a man of seventy than in one of twenty-five.*

Climate has no uncertain effect on the amount and kind of food required. Should you travel in different countries, you would find the people in one of them eating very different food and in very different quantities than the people in the others. *We all know that people in extremely could countries must eat heat producing foods. The Eskimo,* for example, *must take great quantities of fat.* In countries much to the south of us, *where the climate is warm, the heat producing foods, such as meats and fats, are not in much demand. Fruits and vegetables are found much more desirable..*

Adulterated Foods.

The subject of adulterated foods is such a big one that whole volumes might be written about it, and the subject still not be adequately treated. For nearly half a century, the fight for pure unadulterated foods has been going on and the name most prominently connected with this fight is that of Harvey W. Wiley, who for years was chief of the Bureau of Chemistry until his resignation March 15, 1912.

Adulteration of foods have taken many forms—all tending to cheapen the cost of the product. In some cases the result is harmless—the consumer simply pays for inferior material, while in others, the danger to life and health is great. As an example of the first, ground shells and fruit stones are often used to mix with spices, while preservatives and bleaches come under the second heading.

Mixing, preserving and coloring are the three chief methods of adulteration.

Some of the most commonly used adulterants known as chemical preservatives are the following:

Boric acid, formerly much used in meats, milk, and butter.

Benzoic acid, used in preserving catsup, mince meat, and certain fruit juices.

Saccharin, a product of coal tar, used in place of sugar, for sweetening purposes. One part of saccharin has 400 or 500 times as much sweetening power as the same amount of sugar.

Some of the most commonly used adulterants used for coloring purposes are copper, which was used to produce a bright green color in such foods as canned peas, string beans, etc. Caramel, made from burnt sugar, was used to color flavoring extracts, such as vanilla, and to give the appearance of age to liquors.

Tumeric was used tc give a bright yellow color to mustard preparations.

Among the "mixing adulterants" are cotton seed oil, which was formerly much used as an adulterant of olive oil.

Glucose was much used as a substitute for sugar in jellies, jams, etc. Starch was used in jellies to thicken them, also in spices and condiments to increase the bulk.

Coffee has been adulterated in many ways, mainly by the addition of chickory, peas, beans, etc. If ground, the adulteration is more difficult to detect.

Flour, vinegar, butter, milk, and ice cream have all come in for their share of adulteration. Water is the main adulterant of milk, while gelatin that of ice cream.

Candies have suffered much from adulterants. Starch, paraffin, and large amounts of coloring matter are often added.

Source of Food Supplies and Necessity for Cleanliness.

Food sanitation has now come to be a question of the greatest importance. Because of their source or condition, *foods may be the direct cause of many diseases.* With our increasing population and change in commercial conditions the government has found it necessary to take active steps in the guarding of public health. For this there are many reasons, among them being the following:

1. Changes in composition of food due to long storage.
2. Exposure to dust and flies, not only during transportation, but in the city markets.

3. Collection of food materials from sources over which there is no sanitary supervision.

4. Transportation over long distances, with acompanying danger of fermentation and contamination.

5. Presence in canned and preserved foods of certain substances known as adulterants.

Many people condemn the use of uncooked foods as dangerous. To a certain extent this is true. A certain epidemic of typhoid fever occurred in Middletown, Conn., in 1894, which was traced directly to the eating of raw oysters "fattened" near the mouth of sewers.

Fruits and vegetables are a possible source of diseases. Many are raised in manure which is alive with germs. In the city markets, flies swarm over the produce on sale. *For these reasons, the housewife is urged to thoroughly clean all vegetables and fruits and cook them, if at all possible, before they are served.* Such fruits as oranges, bananas, lemons, etc., are rendered safe by a careful washing before the fruit is cut.

With our modern means of transportation, our foods come to us from all parts of the earth. From the shores of Alaska we get our canned salmon, and from the deserts of Arabia our dates and figs. With this diversity in locality, one can easily see the danger incurred unless great care is taken in the home preparation of our foods. Many of them come to us in air tight cartons, factory sealed, and with these little danger is run. However, there are certain precautions that the average housekeeper must take. The greatest care must be exercised in keeping food at a uniform temperature, and away from contamination of all sorts. A modern refrigerator, if properly cared for, is one of the best safeguards to health, but if neglected may become a fruitful source of infection.

It should not be forgotten that food, even when placed in a refrigerator, does not cease to undergo change. For this reason, *ventilation of refrigerators should be perfect and they should be perfectly clean,* especial attention being given to the care of drain pipes.

Preparation of Food. Advantages of Proper Cooking.

It is a famous saying that "civilized man cannot live without cooks." Perhaps there is more truth in it than at first appears. *Cooking is the first step in the process of digestion. It renders the food soft and crisp so that it can be more easily chewed.* With proper seasoning, it is more agreeable to the taste and calls out a more generous flow of the digestive juices. *The heat necessary to cook food also kills any disease germs that may be found in it.* We are speaking, of course, of good cooking. Improper cooking often makes good food harmful to us. Broiling, roasting, and boiling are three good *ways of cooking.* As methods of cooking, they rank in the order named.

In cooking meats, it is best to keep the natural juices in them as much as possible. This can best be done by broiling. The heat almost instantly seals up the meat so that the juices cannot escape. *In roasting, the meat should be placed in a very hot oven or vessel so that the juices may be retained.* The process of boiling depends somewhat upon whether soup is to be made. *If the purpose is merely to prepare the meat for food, it should be placed in hot water, but if one wishes to make soup he should cut the meat fine and place it in cold water and then gradually bring it to boiling.*

Frying cannot be so highly recommended as a method of cooking. The fat used in cooking generally forms a very hard coating over the meat so that the digestive juices penetrate it with difficulty. *Fried food is, therefore, more difficult to digest than if broiled, boiled, or roasted.* Some of the undesirable results, however, can be avoided by having the melted fat and the pan which contains it very hot before putting into it the meat, potatoes, eggs, or buckwheat cake. This renders it more like broiling. *Quick frying is much better than slow frying.* Frying is not without its good points. It is a time saving process and also develops very desirable flavors.

To sum up the reasons for cooking then, we may say that there are three. First, *cooking makes food easier to chew and digest. It bursts the grains of starch, coagulates the jell-like pulp of meats, the white of an egg, and the gluten of flour. It prepares food for the work of the teeth.* You can appreciate

the change by comparing the taste of a raw potato with that of a roasted or broiled one. This was doubtless the reason why cooking came to be done. You need only draw on your experience for proof of this reason for cooking. *Lastly, cooking sterilizes food.* Tribes of Indians who cooked their food were found to have less stomach trouble and lived longer than others. Certain parasites and germs are known to live on meats and fruits. As has been said, the heat of cooking kills them and renders the food sterile.

Proper Serving of Food.

Important as the proper cooking of food is, one must not overlook the almost equal importance of serving.

The dinner hour is the one time of the day when the family is gathered together and in the setting of the table and the serving of the meal, three things should be kept in mind. *There should first be simplicity,* a simplicity which will give a feeling of rest. The second point to be noted *is good arrangement of the table.* A simple, orderly arrangement of cups, knives, forks, and spoons does much to give an air of harmony to the room. *The third point to be noted is convenience.* The table must be set so that each person will have the necessary utensils within easy reach.

Reasons for Regularity and Moderation in Eating.

A keen appetite is one of the main causes of too rapid and over eating. *If one eats too rapidly, he is much more likely to over eat than if his food is taken slowly and thoroughly masticated.* All rapid eaters are large eaters, though most of them are of the opinion that they eat but little, simply because they spend but little time at the table. The only way to cure this too prevalent habit is by forcing oneself to eat slowly. Sometimes physicians find patients' systems so overloaded with food that a strict fast for twenty-four hours must be resorted to until the patient has had time to use up or eliminate the excessive amount of food stored up. Laxatives are often resorted to to aid nature in regaining her normal level.

In most cases three meals a day are sufficient. This is for the normal healthy patient. Special cases of illness are governed by their special needs.

The proper time for the largest meal of the day is in the early part of the day. One of the most absurd customs America copied from European countries is that of having but a cup of coffee and a roll for breakfast and a heavy meal at night. By midnight, if the dinner is eaten at 6:00 P. M., the stomach has completely disposed of its contents and by 8:00 A. M. after its eight hours of rest, is ready for a substantial meal. *Experiments have proved that digestion is more perfect in the morning than later in the day.* But the manner of life for most of us must determine *our habits of eating,* and whatever they may be they *should at least be regular,* for the digestive organs under normal conditions soon become accustomed to caring for food at certain hours, and if it is not then supplied headache and weakness are apt to result. *It is scarcely necessary that one should eat between meals, nor should one eat excessively of candy and sweets.* The pleasant taste of candy and nuts often leads us to overeat of them and brings on attacks of indigestion. *Perhaps the best drink to accompany our meals is water, although milk and cocoa may be used.* The latter, however, are foods as well as drinks.

As to the quantity of food to be taken, *one should always eat a little less than he really wants, and most certainly less than he can. It is not how much, but how well we eat that should be remembered. It is unwise to eat until one feels full and dull.* This would be intemperate and would lead to ill health.

Pleasant Surroundings at Meals.

The mental condition of a person has much to do with appetite and digestion. *Every physician knows* the harmful effects of shame, anger, worry or overwork, and the *good effects of joy and happiness upon one's digestion.* Indeed, the many advantages of good companionship at the table has been known from the earliest times and has been written upon by many authors. To such an extent was this notion carried that *in Roman times all feasts were enlivened by paid singers and dancers.* Today the modern cabaret in our hotels and cafe dining rooms are a survival of this ancient custom.

The nervous system controls digestion, just as it controls all other bodily functions. The secretion of digestive juices and the action of the various organs of digestion are affected by whatever affects the nervous system. *Worry has been known to keep the food in the stomach for twelve hours in just the same condition as it entered.*

Our meals should always be eaten leisurely and under pleasant conditions. The conversation should always be of a cheerful sort. Stories of personal difficulties and grievances are poor topics of conversation at meal times. Parents sometimes find it necessary to correct a child at the table, but this should be done in as quiet a way as possible, for many an attack of indigestion in children can be directly traceable to a "scene" at some meal.

Thorough Mastication.

Insufficient mastication is perhaps one of the most serious as well as the most prevalent offenses against human digestion. Man is practically the only creature which bolts its food without careful chewing. Food, if insufficiently chewed, must remain in the stomach a much longer time than if thoroughly ground up. Here the food is attacked by bacterial growths under the favorable presence of moisture and warmth. Decomposition begins, and the work of the digestive juices are hindered. Then, too, if one does not chew his food thoroughly he is apt to eat a great deal more than if he had chewed it fine. This means that the digestive tract is overtaxed with an undue amount of material, which it must dispose of.

Mr. Horace Fletcher has made some very interesting experiments along this line, and the fact that he is now well past sixty, yet is hearty and vigorous as a man of twenty seems to prove his contention that *most of our ailments come from poorly digested food—the result of poor chewing and rapid eating. Thorough mastication lessens the time necessary for rest and sleep,* since the system is not overworked with products of decomposition. People who masticate thoroughly are soon found to eat less protein than formerly, when they ate rapidly.

The food should be chewed until every particle has been ground to a fine soft pulp. You will be surprised to note fine

flavors you had not noticed before. If you have but five minutes in which to eat, do not hurry. *A little carefully chewed is much better than a great quantity hastily swallowed.*

Care of the Teeth and Mouth.

Most people feel that they understand the care of their mouth and teeth, but few really realize the importance of this care. *If one wants good strong teeth, he should give them plenty of exercise.* One of the best means to secure this exercise is to thoroughly chew all food taken into the mouth. Some dentists deeply deplore the fact that so much of our food requires so little chewing. This is especially true of cereal breakfast foods. *Chewing meats and bread crusts is good exercise for the teeth.* One reason for this is that pressure is put on the roots and the gums become more healthful. *The teeth should be given a thorough cleaning after each meal,* as the bits of food that lodge between them give rise to acids that corrode the enamel. A moderately stiff tooth brush should be used along with some good dentrifice. Some people prefer liquid tooth washes. These are usually beneficial in that they possess antiseptic qualities, but at this their virtue usually ceases. They are rarely harmful. Other people prefer tooth pastes of which the number is uncountable. Here each person must exercise his own judgment, some being good, some being bad, and some indifferent. Too many depend upon a catchy name, an attractive container or a sweet scent to catch the popular favor. While few of them live up to the extravagant claims made by their producers, few of them are really injurious. *Many dentists recommend a tooth powder as the best cleaning dentrifice.* If well chosen this is true, for *there is more scouring material in the dry powder than in paste, but many powders contain gritty material or dangerous acids, which in time will ruin the enamel.*

One should never use any but a wooden tooth pick. *A pin or other metallic substance should never be used, as the danger of scratching or breaking the enamel is great.* One should never crack nuts with the teeth—they were never intended to take the place of steel nut crackers. One should also use great care in biting very hard candies or other substances of this sort.

Much stomach trouble is caused by carelessness in the care of the teeth and mouth. Germs from decayed teeth pass into the alimentary canal and interfere with digestion. This condition is especially serious with babies. *A saturated solution of borax makes an excellent mouth wash.* This solution may be applied to the mouth and gums with a soft cloth. In persistent cases of sore mouth either of children or adults, one should consult a physician. *Rigg's disease or pyhorrea is a disease attacking the gums, causing them to recede.* In advanced stages the gums bleed easily, and the disease may progress to such an extent that finally the teeth loosen and fall out.

It is never wise to defer a trip to the dentist, as this may mean the loss of the tooth as well as increased pain. A tooth should be filled while the cavity is yet small, because it is less painful and the expense not so great. Expensive crown and bridge work is generally the result of neglect to consult a dentist.

Beverages—Water; Necessity for in the Body.

Water is one of the main essentials of human life. In the inorganic foods, it takes precedence since it comprises 66⅔% of the body. It is absolutely necessary to the performance of every bodily function. Man may go days without food, but after twenty-four hours without water, the longing becomes so intense, if continued, often results in loss of reason for the victim.

Water is used largely in the digestion of foods. While some water may be taken with our meals, it is better to drink copiously an hour or so before each meal, then let the salivary glands secret the moisture necessary to moisten the food.

Water is also used in the process of absorption of digested foods. It makes up 90% of the fluids of the body, thus making possible the easy distribution of food materials. Within each living cell water is necessary to all the life processes. The glands make use of it largely in their secretions. For example, 99½% of the saliva is water and 98% of the pancreatic juice is water.

Man had added many things to pure water to increase its palatability as a beverage, but nothing is more effective in slaking thirst than pure cold water alone.

Water from shallow wells should always be looked upon with suspicion as they are very likely contaminated by surface water. Water flowing through sand and gravel is apt to be pure and softer than that which filters through rock. *Driven wells made by driving iron pipes in the ground, are considered the best kind.*

Sources of Drinking Water and Ice Supplies and Necessary Precautions.

Water in general use is obtained from springs or wells. This is especially true of rural districts. Cities depend largely upon their water from lakes or rivers, and use various devices to either protect it from contamination through drainage from factories or house sewerage or to purify it, if such protection is possible. Such cities as St. Louis, located on large rivers, have an adequate supply, but face the problem of purifying it. In St. Louis, one of the best equipped filtering plants in the world is located, where the filtering is carried on in an inconceivably large scale.

Most waters contain more or less mineral salts held in solution, for the most part carbonates. When these waters cause a curdling of soap suds, the water is said to be hard. Springs issuing from sand are usually soft. Wells which draw their supply of water from rock strata are usually hard, since they take the salts from the rock through which they have filtered. Rain water is soft when it first falls, but may later become hard from standing in cisterns. *The boiling of water is recommended when there is a chance of its being contaminated.* This not only kills all bacterial germs, but removes a considerable amount of carbohydrates. Boiled water unless aerated, has an insipid taste. This may be done by putting the boiled water in a jar, leaving it but about half full, then thoroughly shaking the jar. This restores the original flavor.

The average person needs about two quarts of water every twenty-four hours. About one-half of this amount is taken as food. Weather conditions cause our needs of water to vary greatly. On hot, dry days we drink much more than we do on cool, cloudy ones. *As a rule, most people drink too little water and as a result suffer from constipation and kidney trouble.*

As was stated in a former topic, our ice supply depends either upon natural or artificial ice. Natural ice stands greater chance of being impure than artificial, yet unless the latter is made from filtered water, we cannot be sure of its purity.

Every possible precaution should be taken to see that not only the source but the delivery of both water and ice are pure. If not pure, extra precautions must be taken in the home. In regard to water, many devices have been made for its purification, such as filters and chemical reagents, but the safest, surest and easiest is simply boiling, then aerating.

If there is any question as to the purity of the ice supply it should be used only foı refrigeration and never put in any food or drink. *All ice should be washed under running water before being put in the chest or refrigerator.*

Tea and Coffee—Sources—Properties—Effects.

Tea is made from the leaves of a small shrub found growing in China, Japan, and Ceylon. It grows from three to six feet high and sends out four sets of shoots each year. The two small leaves at the top of each shoot make the finest tea as they contain the most juice and the least fiber. These make the Flowery and the Orange Pekoe. The larger leaves farther down the stem are used for the Pekoe, Congo, and Souchang teas, inferior in flavor. Young Hyson and Gunpowder are made from the same grade of leaves. There are two ways of preparing the tea for market, and results in either black or green tea. Black tea is made by withering the leaves in the sun, then rolling them into balls and allowing them to ferment. When fermentation is complete, they are dried in the sun or in a furnace. Green tea is made as black tea with the exception that it is not allowed to ferment before being dried.

The tannin in black tea is rendered less harmful, less soluble by the digestive juices. For this reason, it is more healthful than green tea, but it contains more theine, the stimulant, than green tea.

	Green Tea.	Black Tea.
Tannin	10.64%	4.89%
Theine	3.20%	3.30%

The characteristic flavor of tea is due to various oils. Some of these oils are contained in the tea, others, as fragrant olive oil, is added. The best teas on the market are blended teas from different countries. Teas from different countries have different flavors. While tea and coffee contain some protein and carbohydrates, they cannot be properly classed as foods but as stimulants. This means that they increase mental and physical alertness, and for this reason should not be used by children whose delicate nervous system does not need these stimulants.

The stimulants in tea is theine, in coffee, caffein. Tannin is the most harmful substance contained in tea. The amount in a cup of tea depends upon the length of time the water is allowed to stand on the leaves. Tannin interferes with the secretion of digestive juices and especially with the digestion of protein.

The coffee tree is a cultivated evergreen found in the tropics. In its natural state, it grows to thirty feet in height, but when under cultivation it is kept pruned from six to ten feet in height. The fruit of the tree resembles a cherry. In this fruit are two seeds embedded. These are the coffee grains. The fruit is dried, the seeds removed, cleaned, and graded.

Coffee has an entirely different composition from tea. It is high in fat and soluble carbohydrates. It also contains caffein, an alkaloid identical with theine.

The following table will show the difference between green and roasted coffee.

	Raw.	Roasted.
Water	11.23	1.15
Ash	3.92	4.75
Fat	12.27	14.48
Sugar	.66	8.55
Protein	12.07	13.98
Caffein	1.21	1.24

The greater amount of sugar and other soluble carbohydrates in the roasted article is due to the effect of the heat upon the non-nitrogenous compounds.

Since only a small part of the nutrients are soluable and available coffee cannot be considered a food. It is a beverage

with mildly stimulating properties. Coffee acts with different effects upon different individuals. Some people should never use it. while others seem immune to its action. Since coffee is more generally used in this country than tea, it is more subject to adulteration. There are three kinds of coffee in general use—Mocho, Java, and Rio or Brazil. The former is considered the best, while the last is usually styled by dealers as "low" or "low middlings." Mocha commands the highest market price. The seeds are small and dark yellow before roasting. The Brazil has the largest berry. The active ingredients of coffee is caffein. This substance stimulates the cells of the body to do extra work. It has a tendency to create an appetite. As a stimulant, its action is vigorous, both on the nerves and the digestive system. Children should never be given coffee as they do not need it, and their nervous systems are too readily acted upon by it. For most grown people, its moderate use is not to be condemned, and in some cases following cold and exposure, its use is very beneficial. It should never be drunk at night as it has a tendency to produce wakefulness.

Nourishing Drinks; Milk, Chocolate, Cocoa, and Cereal Drinks.

Some drinks have the proprieties of foods and are therefore known as nourishing drinks. *Among them are milk, cocoa, chocolate, and all sorts of cereal drinks.*

Milk is both food and drink. For young animals it is a perfect food up to a certain age, but in that it does not contain iron, the growing child after the period of infancy requires more bone building material. It contains not only protein and energy yielding substances, but also almost all the minerals needed by the body.

However, its composition is such that life may be sustained for long periods on milk alone and in some diseases milk forms almost a sole diet. Fat is one of the most valuable constituents of milk and varies from 2% to as high as 6% or even more. The main difference in milk is in the fat content as the ash, albumin, etc., do not vary much in different milks. The variation in fat depends upon the feed, time of the year, breed and individuality of the animal.

Milk is one of the most completely digested of all foods used by the body. About 95% of the protein and 97% of the carbo-

hydrates are taken up in digestion. Some people cannot digest milk easily. This is because it coagulates and forms a mass resistive to the digestive juices. This may be prevented by eating crackers or bread with it.

Pure milk is one of the most wholesome of all foods, but it is also one of the greatest sources of danger from disease unless produced under sanitary surroundings. Some of the most frequent sources of unsanitary milk are: unhealthy animals, poor food, dirty barns, impure water, and lack of care in the handling and delivering of the milk.

Chocolate is the finely ground powder from the bean of the cocoa tree, a native of the American tropics. The beans are about the size of almonds and are taken from their pod and allowed to ferment usually, in ovens, for about two days. This fermentation determines largely the flavor of the finished product. The beans are next dried in the sun, where they change from white to their characteristic chocolate color. They are next roasted and the husks removed. They are next ground and sold as cracked cocoa or cocoa nibs. If cocoa is desired instead of chocolate, some of the fat is presed out and sold as cocoa butter. If sweet chocolate is desired, sugar and flavoring are added.

Tannin is found in the raw bean, but is changed during the drying and causes the reddish color.

Certain cereal drinks are regarded as more or less nutritious. Some of these preparations contain a little real coffee, but for the most part are made of wheat, barley, or of grain mixed with pea hulls, ground corn cobs or wheat middlings. To these New Orleans molasses or other sweetening is added. Their main claim to superiority is that they are non-stimulating, but a few lovers of coffee will accept them as comparing in flavor to a good grade of coffee. As far as nutritive value is concerned, parching probably renders some of the carbohydrates soluble, but it is so little that as foods they are not worth considering in the dietary.

Non-Alcoholic Refreshing Drinks, Lemonade, Orangeade, Unfermented Fruit Juices, Fruit Syrups.

Especially during the hot months of summer, certain non-alcoholic drinks are very refreshing. These are made from the

juices of various fruits, the most common of which are lemons, oranges, pineapples, grapes, strawberries, and various other kinds of berries. These are of little food value, since the amount of juices contained is small, but they are cooling, do not create an appetite, and the action of *the acid contained in them is highly beneficial to the digestive system.*

Fresh fruits are composed largely of water. Bananas are three-fourths water; strawberries nine-tenths and such fruits as watermelons are even more. It is not because of their nutrients that they are valuable in human diet, but because of the chemical reaction they cause to take place. A diet of cereals, meat, and eggs cause an acid reaction in the system, but the action of a fruit diet is alkaline, hence the need of the latter. The bulkiness of fruit and vegetables is beneficial in counteracting a tendency to constipation.

The sugar found in ripe fruit is known as fruit sugar and is two and one-half times as sweet as ordinary sugar. Their organic acids, as malic acid in apples, citric acid in lemons and oranges, and tartaric acid in grapes, have characteristic medicinal properties. The essential or volatile oils are the compounds which give each fruit its characteristic flavor.

Lemonade is made from the juice of lemons, sugar and water in varying degrees. Orangeade is made in the same way. The grape fruit in recent years has come to be very widely used, and while seldom used alone as a basis for a drink, is especially palatable if combined with other fruit juices.

Strawberries are a valuable addition to non-alcoholic summer drinks. Their value is a high dietetic value rather than a real food value.

Grapes contain more dry matter than either apples or oranges. Their juice when thinned with ice water is especially good for sick folk or invalids.

While fruit juice drinks are especially commended for hot weather use, the greatest care should be used if they are purchased rather than made in the home. There is no article of food more readily adulterated than this class of drinks. Some times the substitutes are harmless enough, but often pernicious coloring matters and chemicals are used in their manufacture.

In many bottled drinks now on the market, there is not one particle of real fruit juice used. This is especially true of pineapple juice, which, if pure, is very expensive, but which can be manufactured by a chemist at a fraction of the cost of the genuine. Pineapple flavoring is the ethyle butrate. This may be made from butyric acid from stale butter and alcohol.

Banana flavor can be made from stale butter, caustic soda and chloroform. Thus we see how necessary it is that we know the source of our flavoring extracts.

Those fruit syrups made at home, and which are often left from the canning season, are the best, safest and cheapest to use, and the thrifty house wife who can look over the shelves of a well stocked fruit closet and see cans or jars of strawberry syrup, pineapple juice, peach or plum syrup, and grape juice can feel well satisfied with her summer's work and may rest assured that she has not only a safe, clean source of healthy drinks, but that in case of sickness she has a reserve upon which to draw that money could scarcely buy.

The Nervous System.

Even the well built, well nourished body could not exist without something more. This something is the nervous system that raises man above a mere vegetable or even in many respects, above the animal.

We can think of the body as a beautiful house. But if from this beautiful home we would take all the electric wiring it would prove to be a dark cheerless place. There would be no electric lights, no telephone, no radio, no electric sweeper, toaster, perculator or any of the many modern conveniences found in well equipped homes. In many even the heat is dependent upon electricity either from electric heaters or motors that drive all into the furnaces.

The body would be in much the same condition if we deprived it of its nervous system. We could not move, smell, see, think, hear, feel, taste, in fact, have no greater life than does a cabbage in the garden. It would perhaps not be too far to go to say that we could not have life itself. Since the nervous system then plays such an important part in our well being, let us then see what it is and how it performs its duties.

Under the nervous system scientists place the brain, all the nerves of the body, and the spinal cord. The nervous system is made up of white and gray matter. By many authors, the brain has been compared to the superintendent of a large factory, in that it controls and directs all the activities of the body. Sometimes it acts under our will or direction; in other cases it acts independently of our knowledge or wish. It seems to be a sort of telephone exchange where all messages are received and sent to other parts of the body. When we speak of the brain, we generally think of it as the organ with which we do our thinking; of course this is true but its use is far greater than this.

The brain is divided into three distinct parts, yet all are associated together. The *cerebrum* is the part of the brain that fills the upper and front part of the skull. The cerebrum is the seat of the thinking mind; the *cerebellum* is the part of the brain that is in the back part of the skull.

Great scientific men have agreed that the real functions of the cerebellum are not known; the third part of the brain is the *medulla oblongata;* this is simply the upper extension of the spinal cord.

The average weight of the brain of a man is about three pounds. It is about four or six ounces lighter in a woman. It is divided lengthwise into two halves each shaped similar to a coffee bean. It seems strange to know that the right side of the brain controls the left side of the body and vice versa. The brain is covered with three membranes; the middle one secretes a fluid. These membranes protect the brain. The brain is made up of two kinds of matter, the white and gray matter. The gray matter is the most important and serves as the outer covering of the brain. The white matter seems to be mere bundles of wires carrying messages from one group of gray matter to the other.

Nerve Cells.

Many of the nerves end in little round bodies; these bodies are the nerve cells. These cells are composed of gray mattr, and are from 1/1200 to 1/2000 of an inch in diameter. Think of the difficulty the scientists must have had to study these cells. The number of such cells in the body is much past computation,

but in the brain alone it is estimated that there are more than 8,000,000,000. There is no part of the body that is not connected with some such cell by a nerve fiber. In the brain mostly these cells lie on the surface, for unlike other parts of the body, the soft gray matter is here protected by a hard, bony covering and is less exposed to injury than are the cells which are found in the muscular parts.

Nerves. Nerve Fibers.

The nerves are like little threads, comopsed of white matter on the outside and gray matter within. They are found in all parts of the body. The nerves are made up of a bundle of little threads called nerve fibers. The nerve threads are of various sizes, from 1/4000 of an inch in diameter to the great sciatic nerve of the leg which is as large as the end of the little finger. It seems that all the nerve fibers have a connection with the spinal cord, and then with the brain; they are cylindrical in shape and on the outside are covered with a covering of fat. This is a sort of protection for the nerves and at the same time helps them to retain their shape. The nerves act with great quickness and transmitting messages is the main work of the nerves. The nerve fibers seem to be the mere conductors of nerve force. They are means of communication between the nerve centers and the outside of the body. These nerve centers are composed of cells made up of gray matter, and it is in this part that nerve force originates.

Cerebro-Spinal Nervous System.

As has been stated before, all acts of our body are of two kinds—voluntary or involuntary. When we move the arm and pick up a book, the act is voluntary or conscious on our part, but the muscles that control our heart, lungs, and many other organs of the body are under the control of nerves which act quite independently of our will. The former set of organs—those which we consciously control—are known as organs of animal life and are regulated by the cerebro-spinal nervous system, while the latter organs—those not under our control—are known as the organs of organic life; these are controlled by the sympathetic

system. As the name of the cerebro-spinal nervous system indicates, it is composed of the *cerebrum,* or brain, and the *spinal cord.* This is the only part of our nervous system over which we have any control. But it comprises by far the greater part of the nervous apparatus. It includes not only the brain but the spinal cord, and all the nerves which take their origin in these parts.

Cerebrum.

The cerebrum fills all the upper part of the skull. In weight it comprises about 7/8 of the entire brain. It is a mass of white fibers, surrounded by masses of gray cells. In appearance it is somewhat like the meat of an English walnut with their curiously ridged surfaces. This formation gives a large surface for the placing of much gray matter. In an infant the cerebrum is smooth with no ridges, while in a person with great mental powers the ridges are deep and intricate. The two hemispheres of the cerebrum have a connection on the under side by fibers of white matter. The cerebrum by many experiments has been proven to be the center of thought and intelligence. That part of our being we know as our mind has been its center. It centers our will power and controls our voluntary acts.

Spinal Cord.

The spinal cord is about eighteen inches long and about one-half inch in diameter. At the center of the cord is a tiny canal, which is directly connected with the cavities of the brain. It is covered with three coats similar to the coverings of the brain. This cord is soft and white and occupies the upper two-thirds of the back bone. It reaches about to the lowest rib and at its lowest end it branches into a number of nerves similar to the hairs in a horse's tail. The spinal cord is a great helper to the brain for it performs some work without the aid of the brain. We have no control over it at all. It orders the cells to be fed, and also orders the arteries to carry the blood to the cells. It is well protected by the vertebral column. The spinal cord gives off thirty-one pairs of nerves known as the spinal nerves. These pass through openings between the rings of the back bone. It is composed of two kinds of matter, the white and gray; the latter being in the center.

Arrangement of Nerve Matter in the Brain and Cord.

As we already know, the nervous system is composed of two kinds of matter—white and gray. In the brain, the gray matter forms the covering, while the white, or nerve fibers, are on the inside. When it comes to the spinal cord the reverse is true, and here we find the white matter as the outer sheath. We have also seen how the nerve fibers start and end in gray matter or nerve cells. Sometimes where a nerve runs through a mass of gray matter, little knots are formed, known as ganglia. In fact, wherever gray matter is separated from other gray matter and united by white nerve fibers, these separate bits may be called ganglion. Even the different parts of the brain may be classed under this name.

The Cranial Nerves.

There are twelve pairs of the Cranial nerves. They spring from the medulla and the lower part of the brain.

The *first* pair is called the olfactory nerve and is the nerve of smell, sent to the nose so that we can appreciate odors. The *second* pair is called the optic nerve. It controls our sight. The *third* pair has nerve fibers distributed to the muscles of the eyeball, and with the *fourth* and *sixth* pairs, regulate all the movements of the eye. The *fifth* pair is the tri-facial, and divides into three parts; the first goes to the upper face, eyes and nose; the second, to the upper jaw, temples, cheeks, upper lip, teeth, and palate; the third, to the lower jaw, side of the head, lower part of the face, and skin of the external ear. The *seventh* pair of nerves are distributed over the face and give it its expression. The *eighth* pair is the nerve of hearing. The *ninth* pair is found in the mucous membrane at the back of the nose and pharynx. The *tenth* pair, by its motor fibers, controls the larynx, lungs, liver, kidneys, intestines, and heart. The *eleventh* pair controls the movement connected with swallowing, also the vocal section of the larynx. The *twelfth* pair is distributed to the muscles of the tongue, and control its swallowing, also the speech.

Spinal Nerves.

The spinal nerves issue from the spinal cord through openings between the rings of the backbone. Each spinal nerve

springs from two roots—an interior and a posterior—the former is the motory and the latter the sensory. Both of these roots unite to form one nerve; they remain as such until they reach distant parts of the body, then they separate again. The spinal nerve fibers which started from the motory root end in the muscles, and the spinal nerves which started from the sensory root end in the skin. Those that end in the muscles tell the muscles when and how to act. Those which end in the skin bring to our consciousness feelings of heat, cold, pain, comfort, touch, etc.

Reflex Action. Its Importance. How Habits Are Formed

The greater part of the spinal cord is composed of white matter, but the inner portion is gray matter. This wise arrangement by nature saves the brain much work. This gray matter attends to many of the simpler acts of the body without asking aid of the brain. In this way we, while asleep, perform many acts without knowledge on our part at all. If the body grows tired in one position, the impulse is carried to the gray matter of the spinal cord, the nerves cause the muscles to contract and our position is changed without the brain being troubled in the least. In this way we save ourselves many times from accident when we jerk the hand or dodge to prevent ourselves injury. This is known as "reflex action," and is performed much quicker than an act could be performed if the message had first to be communicated to the brain. Not only this, but, if it were not for reflex action, we would be compelled to think every time we breathed, and, indeed, every time our heart beat. Thus we see that our whole time would be devoted merely to the functions of life. As it is, an act which at first requires all our attention in time becomes purely mechanical. Upon this truth all the possibilities of education, culture, and habit are based. When we once do a thing or think a thing, it leaves upon our brain a definite impression which has a tendency to cause us to repeat the same thing again. Thus it is by concentrating our minds upon some act and performing it again and again, it at last becomes as we say, almost "second nature." This shows how our physical and mental life are intertwined and how important it is that we form habits of industry and sobriety, for even if we wish to change our manner

of living and drinking, and really make serious efforts in this direction, we can never be sure that traces of our old evil ways are not yet stamped upon our brains, and will some day confront us when we are least ready to own them.

The Sympathetic Nervous System.

The sympathetic nervous system consists of a series of ganglia, extending from the head through the neck, thorax, and abdomen to the pelvis. There are four main pairs in the head and twenty-three in a row down the front of the backbone. These send out fibers to the blood vessels and the inner organs of the body. These ganglia vary much in size—some being as large as a pea while others are microscopic. They are made up of gray matter and are connected with each other and with the spinal cord by the nerve fibers. The two principal ganglia of the abdominal cavity are the largest in the system, and the branches from these unite to form the solar plexus, which lies just back of the stomach. This ganglion sends nerves to the different abdominal plexuses and also to the blood vessels that lie in course of the intestines and the other abdominal organs. The sympathetic system furnishes the main part of the nerves controlling digestion and secretion. The sympathetic system of nerves is much slower in action than the cerebro-spinal system. A person may have his sympathetic system of nerves diseased, but the trouble may not declare itself for hours, while with the cerebro-spinal system the warning is instantaneous. Not much knowledge can be gained from the study of this system of nerves because of their sheltered position, also because it is difficult to separate them from the cerebro-spinal nerves.

Its Use to the Body.

The process of digestion is mainly regulated by the sympathetic system. When we eat, the food irritates the nervous ganglia of the abdomen, and, through their influence, the whole work of digestion and absorption is carried on. The sympathetic nerves may transmit both motor and sensory impulses.

The ganglia are constantly receiving impulses from the sensory nerves, letting them know of the needs of the cells, the

organs of secretions, and the movements of the arteries and digestive organs. In answer to these, the ganglia sends out commands to the gland cells to produce their secretions, and to the muscles of the arteries and intestines to expand or contract. When one organ is affected by disease, all the other organs likewise seem to be deranged. This is due to the action of the sympathetic system of nerves, so called because they seem to make the various organs act in sympathy with one another. One fact is of interest in connection with the study of this system, and that is, the brain has no direct control over the ganglia.

Hygiene of the Nervous System—Rest

Rest is as essential to the brain as it is to the body. Rest may take on several forms. The one we usually resort to is change of occupation. If during the day, we have been concentrating our attention on some one thing for quite a time, we find our interest lags, our mind refuses to act clearly, and we say we are brain tired. One of the most valuable habits which we can form while still young is that of mental concentration. But in order that our minds may concentrate upon any thing it must have frequent intervals of rest and recreation. Each must choose his own time and manner of mind rest and recreation. What would rest one would be work for another. But one rule will be found true in all cases. If we wish to rest our brains and give them recreation, we must do something we want to do, and not because we must.

Sleep.

The most complete kind of rest for both body and mind is sleep. When we are in a dreamless sleep, our minds are entirely at rest. If we dream, some parts of the brain are at work. The amount of sleep needed various with the person. Very young children need ten or twelve hours a day, while eight to ten is sufficient for adults. Some people have been known who got along with as little as four hours per day, but such persons were usually known to supplement this meager allowance with frequent "cat-naps". It is said that Napoleon never remained in bed more than four hours, but it was a well known fact that he slept for

hours at a time while riding horseback with his armies on the march. Much less sleep is needed by old than by young people, for an old person's activity during his waking hours is correspondingly less than that of a young person. Sleep has been defined as a rest from conscious effort. It should be regular, and not broken into, so that the body and brain may form regular habits in regard to their rest.

The Five Senses.

From this complex system of brain, nerves, and spinal cord, we naturally expect most exact results. As we have already seen, they operate for the most part through what we know as the five senses. The brain being inclosed as it is in its tight box of bone, must have some special way in which it may come in contact with the oustide world. This is through the organs of hearing, seeing, smelling, tasting, and touch. There are many impulses which may send the sensation of touch to the brain, because the nerves carrying such messages are scattered all through the skin. For this reason it is often called the "common sense."

Light usually starts impulses from the eye to its nerve, and thus to the brain, while sound excites the nerve of the ear. These nerves, then, we speak of as the nerves of sight and of hearing. Some substances excite the nerves of the tongue and we say a thing tastes so and so, while others, acting upon the nose, cause us to recognize smells.

Sense of Touch.

Studying the sense of touch, in a way, is a mere review, of the actions of the sensory nerves. The special sense of touch is aroused without the need of any special organ. When the epithelium of the skin is brought in contact with anything, a feeling of temperature, a sense of weight, or a feeling of touch, or pain is carried to the central nerve cell.

All these experiences are usually included under the general term, touch. By means of this sense we gain our ideas of size, shape, moisture, and surface fiinish. A sensation may not be unpleasant in itself, but if too frequently repeated or repeated with

too much violence the result may be pain. This is not an evil in itself but really one of the bodily protections. If it were not for pain, we might injure ourselves seriously without recognizing the fact. Pain, as one physician describes it, is supplication for more blood. Where the tissues are highly developed, there we will find the greatest number of nerves, and the greatest suffering when diseased, for the nerves are the sentinels warning us of injury to these parts. This sense is most fully developed in the forehead, the face, the tip of the tongue, the fingers, palms of the hands, and the toes and soles of the feet. The sense of touch is the first of the special senses to be developed.

Sense of Taste.

The sense of taste is located on the tongue, and upper and back part of the mouth. By this sense we are protected in our selection of food. This was truer in our early ancestors than it is now, for, by eating many highly seasoned foods and by the use of much condiment, we have almost abused our sense of taste until it has lost much of its delicacy. All solids and gases must be dissolved before they can be tasted. Four tastes are generally recognized—bitter, sweet, sour, and salty. The sense of taste by many is considered to be wholly on the tongue. This is but partly true. The under side has no sense of taste, while the back and roof of the mouth has a strong sense of taste. The tongue is the principle organ of taste. The tongue contains numerous glands, as well as numerous bunches of papillae which are concerned with the sense of taste. A great many times when we imagine we taste a thing, it is really our sense of smell, which carries the sensation to the brain. For this reason, many things are insipid and tasteless when we have a cold in the nose. The back of the tongue is more sensitive to salt and bitter substances, while the edges are most sensitive to sweet and sour substances.

Sense of Smell.

The nose is the chief organ of the sense of smell. It is by far the most delicate of all senses. In order that odors may be perceived, air must pass through the nostrils, therefore a person generally sniffs when he desires to perceive the odor more keenly.

The sense of smell is more highly developed in animals than in man. The sense of smell enables us to detect many poisonous gases which, in time, would prove harmful. It also guides us in the selection of our food, and warns us against bad air, and unhealthful places. In order for us to smell objects, it is not necessary for the object to touch the nose, for the air containing the odor of the object is drawn into the nose.

Use of These Special Sensations.

The senses of touch, taste and smell are guards for us which wise nature has developed for the special protection of our bodies. One has but to touch a hot stove slightly, when the touch sense warns us of danger. Were it not for this, we might fatally injure the body without knowing it at all. The sense of taste among civilized people is more aid to enjoyment than real protection for, without it, all food would taste alike to us. Among the lower forms of civilization and among animals, it is a protection against harmful substances, for almost all poisons have a peculiar, unpleasant taste. Our sense of smell aids us in detecting obnoxious gases and such harmful air poisoners. It really is a sentinel for the lungs in that it makes it unpleasant or impossible to breathe air harmful to the lungs in any way.

Hearing. Parts of the Ear.

The outer part of the organ of hearing, commonly known as the ear, really has very little to do with hearing. It merely collects the sound waves and conveys them to the ear proper. This inner ear is within the head, buried in the bones. The bone in which the inner ear is buried is often called the stony bone, and is the hardest bone in the body. The ear is one of the most complicated organs of the body. From the outer ear a small passageway leads. This is slightly bent up, then curves downward, and is kept soft and moist by the secretion of ear wax. This passage is shut off from the middle ear by a heavy membrane called the tympanic membrane or ear drum. Behind this is a cavity or middle ear. In this are found the three ear bones. This cavity is filled with air supplied through the Eustachian tube. Beyond the middle ear is the inner ear, and here is found the true organ of hearing. In this part there are many nerves.

Sound waves striking the ear drum agitate the earbones which, in turn, carry the sound waves to the nerves of the inner ear. When these carry it to the brain, we say we hear.

Structure and Use of Each Part.

The outer ear as we have seen, is composed of rings of cartilage covered with skin and serves largely as a sound wave collector. The passageway concentrates these waves upon the ear drum which in turn pass them on to the bones of the ear. These, by vibrating, stimulate the nerve of the inner ear and over this the sound is conveyed to the brain.

How We Hear.

Whenever one object strikes another, sound waves are produced which resemble waves on water when a stone has been dropped into it.

These sound waves increase in diameter until they strike the ear drum. When the ear drum or tympanum vibrates, the impulse is passed on to the ear bones which, in turn, convey it to the fluids of the inner ear. Here the nerve catches the impulse and carries it to the brain and we hear the sound.

The bones in the ear, although very small, are covered with a periosteum, have cartileges, ligaments, and muscles. On account of their shape are called hammer, anvil, and stirrup bones.

Relation of Hearing to Speech.

Strange as it may seem, the sense of hearing and speech are closely related. Children born deaf cannot talk, not because the organs of speech are not developed, but because they cannot learn by hearing how sounds are made and modulated.

With in the last few years deaf mutes have been taught to talk so they can be understood, but their voices are usually hard, high pitched, and unmodulated, much like a cheap graphophone.

Hearing Affected By Growths in the Throat.

When we learn the importance of the Eustachian tube in keeping the air pressure equal on both sies of the ear drum, we

realize how necessary to keen hearing it is that this tube be kept healthy and unobstructed. When a physician examines a person for deafness, one of the first places tested is this passageway.

Frequently colds which have led to a catarrhal condition are the most usual causes of trouble to this tube. Not only may a catarrhal condition be the result of neglected colds, but the inflammation may spread back into the pharynx. Here then are a set of tonsil-like glands which may become inflamed until they block the passageway into the nose, entirely up, and one is forced to breathe through the mouth. These swollen bodies are now known as adenoids, and are a fruitful source of deafness, earache, and kindred diseases among children.

It has been proved that all mouth breathers are defective in hearing.

Seeing. The Eye; Coats.

The eye is the organ of sight; it is nearly sperical, and about an inch in diameter. The eye is carefully inclosed within the bony box of the skull. It is protected by an overhanging brow, two muscular curtains that can close over the eye, and the eyelashes at the edge of the lids which prevent particles of dust and other substances from entering the eye. The eye is covered by three coats. The first is the sclerotic coat, which is a white, thick tough membrane, which gives shape to the eyeball. The sclerotic coat covers about five-sixths of the eye, and the front one-sixth is called the cornea. The second coat is the choroid. It lies under the cornea. It is the part of the eye which contains the coloring matter which gives the dark color to the interior of the eye. This iris is in front of the cornea. It is the visible colored part of the eye in the center of the cornea is a round hole called the pupil. There are muscles around the pupil which can make it larger or smaller.

Suppose we go from a well lighted room into a darker room we cannot see until the muscles allow the pupil to become larger so that more light can enter. The third coat is called the retina semi; it lies in the back of the eye and in this are spread the optic nerves. This retina is very smooth, thin, and of a grayish white membrane. It is not sensitive to anything but light.

A blow on the head which might cause pain in the outer coats of the eye might not hurt the retina at all.

Humors of the Eye.

There are two humors in the eye—the aqueous and the vitreous. The aqueous is between the cornea and the crystalline lens. The vitreous humor fills the space back of the lens. If it were not for these two humors, the eyeball would lose it shape.

The iris is another part of the eye and has an important work to perform. It gives the eye its color and varies from blue to dark brown. It is controlled by muscles. In the center of this iris is a small, round, black hole. This hole is the pupil. The muscles of the iris control the pupil so that the right amount of light can enter.

How We See.

In our study of the ears we learned how sound waves were carried by the air to the ear. In much the same way, waves of light are carried through the air, or by the ether to the eye. A sound is produced by air waves, so light is produced by ether waves. Any light sets in motion waves of ether, which pass through the pupil of the eye to the retina where they are transmitted by the optic nerve to the brain, and then we see the light.

Care of the Eye.

There is scarcely any part of the body we abuse more regularly than we do the eyes. Many pupils are born with actual defects of vision, which must be remedied or they will in time prove serious.

Reading in a poor light or on the train are two of the most common ways we abuse the eyes. We should never read or study with the light directly before the face, but it should always come from the back or from over the left shoulder. There are many diseases—especially fevers and measles, which leave the eyes in a weakened condition and it is very necessary that, after such sickness, the eyes be given a period of absolute rest. We should never read while lying down for this is very harmful to the eyes.

Whenever our eyes burn and begin to ache, it is a sure sign they are tired and need rest.

Care should be taken that when particles get into our eyes they should be removed before the eyes become inflamed. Never rub the eyes with the fingers, first, it is not polite; second, we might introduce a foreign matter. Every person should have his own towel. Many persons have contracted serious diseases by using a towel that some one else who had a contagious disease of the eyes had used.

Methods of Resting the Eyes During Class.

We may rest our eyes in several ways during class work. Suppose we have been studying very hard and have had our eyes closely fastened on our books. We may rest our eyes by looking out of the window at some object in the distance. Sometimes a mere change of light direction will rest the eyes, therefore, it is a good plan to have pupils exchange seats during class recitation. Merely closing the eyes for a few minutes will rest the eyes. Bathing the eyes in hot water is also good for them.

Common Defects of the Vision.

Color blindness is a common defect of sight. When a person is troubled with this, he is unable to distinguish between certain colors. Usually the trouble is between red and green. This is an important matter among railroad men and sailors, where it is necessary for them to know the red and green signals. In all parts of the world special attention is being paid to this subject, and the eyes of all railway men and sailors must be systematically tested.

Another common defect of vision is that known as farsight. This is caused by the lens of the eye becoming too flattened. In this case the persons so afflicted cannot see objects close to them as well as they can those at a distance. This defect can be easily remedied by wearing proper glasses. Another common defect is near-sightedness. If a person is troubled with this, it is necessary to hold the object or reading matter close to the eyes. This is apt to cause the person to lean over so that he will be near to that

which he wishes to see, and, after a time, might cause round shoulders. Near-sighted people must wear suitable glasses.

Another defect is astigmatism; it is not so common as nearsightedness or farsightedness. It is caused by the lens in the eye being curved more in one part than in another. This also may be remedied by properly ground glasses.

Cataracts are thickening of the lens, and may be relieved by having an operation performed. The physician will remove the lens, but spectacles must be worn afterwards to take the place of the lens.

Effects of Alcohol and Tobacco Upon Sense Perceptions.

We have learned that alcohol is dangerous to all parts of the body, but in our past work we have learned that wherever the nerves are most numerous, the effect of alcohol is most keenly felt. The organs of sense, besides being supplied with nerves, each has its own special nerve. When we had our study on the organs of speech, we learned that they were seriously affected by both tobacco and alcohol. Tobacco causes a constant hacking cough, while alcohol weakens the muscles controlling the vocal cords.

On the eye, we find alcohol works great harm by weakening the optic nerve, while the effect of tobacco is still greater. Both dim the vision.

Thus it is with all the special organs. These organs depend upon the nerves for their accuracy and delicacy of perception, and if these nerves are soaked in alcohol and their tissues become inflamed and hardened, we cannot expect the same service from them as from healthy, well kept and well nourished nerves. Many persons have cured their defective eyesight by quitting the use of tobacco.